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A REVIEW OF GRASS FARMING IN NEW ZEALAND.

THE BASIS OF DEVELOPMENT, PRESENT STATUS AND PROSPECTS.

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[Portion of 1933 Presidential Address to the New Zealand Grassland Association at Christchurch.]

THE present is a most momentous period in the history of New Zealand grassland development. In the past the position has been clear enough, and it is perhaps as well to epitomize the stages of development through which it has passed so that the essential problem of the present one can be brought into reasonable perspective.

1. The first phase in New Zealand grassland history was represented by the exploitation of the natural grasslands, the open country being naturally first brought under stock control.

2. The second phase represented the replacement of natural units of vegetation by artificially produced grassland, largely without ploughing—a phase originally viewed essentially as a prelude to development along the line of arable farming extension.

3. The third phase was the real recognition that our climate, for the most part essentially a rain-forest-producing one, is therefore particularly adapted for the artificial development of artificially controlled permanent high-producing grassland. It is this recognition that has in the past definitely moulded the major agricultural policy of New Zealand along the line of grassland farming, and more and more along the line of the most intensive type of such farming—namely, the production and utilization of permanently milk-producing pastures. Thus the dairy cow, the ewe, and the sow represent in our intentional development the essential elaborating machinery for our grass crop, and butterfat and rapidly maturing meat the essential products. It has been on this basis that our grassland potentialities have been framed—the extension of milk-producing pastures to their utmost; and their utilization to their utmost has become the established major agricultural intention of New Zealand. The acceptance of this third phase of grassland development carried with it the recognition of the great potentialities of New Zealand increasing her grass crop and improving the utilization of this great crop by the adoption and standardization of grassland practice based

on the critical interpretation of developing experience buttressed by investigation and research enabling such interpretation to be accurate. The recognition that the possibilities ahead of scientifically directed grassland management were extensive has virtually become stereotyped into two current expressions—" We have only scratched the surface," and " External markets are limitless," the last one, indeed, having become more and more circumscribed into " Great Britain can consume all we can produce."

The acceptation of these two statements has unfortunately tended towards the capitalization, largely with borrowed money, of our grassland potentialities well ahead of their realization ; this would be of no moment if our easily realizable expansion were allowed full play, but otherwise becomes serious and may necessitate considerable modification of our agricultural policies.

The statement that we have merely scratched the surface so far as grassland progress is concerned remains true enough, but its important corollary, making deeper scratching logical, that there are rapidly expanding markets for all that can be produced has been questioned.

It is the questioning that the practical potentialities of full grassland production are greater than the practical potentialities for consumption that necessitates a review of our grass-farming concepts, and particularly does it necessitate a wider outlook on the part of all our investigational and research grassland workers than hitherto when the statement went unquestioned. Personally one is inclined to think of the rather world-wide conception that agricultural production—*i.e.*, essentially along the line of foodstuffs—should be curtailed rather than expanded as being basically unsound so far as the welfare of humanity is concerned, and that a conception which is basically unsound cannot be permanently integrated into civilization. It may, however, be necessary, purely as a temporary measure, for it to be adopted for the special purpose of creating scarcity as a prelude to the necessity of again furthering expansion. But this looks to be a clumsy method of approach. So far as grassland is concerned there have been no revolutionary discoveries that would tend toward the replacement of live-stock as food and clothing elaborators, poor as they undoubtedly are in this direction when one bears in mind that our 80,000,000 tons of grass in New Zealand become " Bovrilized " down into 300,000 tons of meat, less than 200,000 tons of butterfat, and 100,000 tons of wool—a dry-weight matter production that could be secured by 500,000 acres of wheat instead of the 30,000,000 acres of grassland. One has always viewed the danger to grassland expansion as coming from bringing about the elimination of the double handling, as it were, that takes place in the production of animal foodstuffs rather than through the creation of 30,000,000 unemployed and their families becoming short of food. One feels that under expansion, still-stand, restriction, or what you will, the necessity for better grassland knowledge, better and increasing grassland research, that will lead to better efficiency in grassland management, remains of paramount importance and becomes even more essential so far as New Zealand is concerned under still-stand or slow extension than it would be under

rapid expansion. The main point, however, is that research and investigation under the former circumstance of necessity must be oriented on a philosophy differing appreciably from that based on the expectation of rapid perpetual expansion where increase in production has been the essential and almost the only viewpoint in the attempted solution of nearly all grassland problems. What is now needed is the getting-down to the real fundamentals, both individual and national, of *efficiency* in grassland management, rather than assuming, to the extent that has been done in the past, that volume increase is essentially the index whereby efficiency should be measured. One, however, rather feels that under semi-developed conditions such as largely exist in New Zealand increased efficiency automatically means larger increase in production, but that in itself is a matter for investigation. Just what constitutes individual and national grassland management efficiency, either separately or in combination or co-operation in the light of a definite rather than an expanding output, certainly looks to me a philosophical economic problem on which we should have definite knowledge, and that such knowledge should more or less control the development of research progress and be equally applicable under expansion. In this connection, might I express the opinion that, linked up with grassland management from the national viewpoint, the question of widening rather than narrowing the scope of grassland products is one of perhaps far-reaching importance. In one small particular in this respect I hope the conference will be constructive—namely, with regard to pedigree pasture seed growing where the inter-relation of production, certification, and marketing are all of particular significance. Apart from economic considerations, there are a few features in connection with grassland that I should like to place before you.

(1) The Variability of Butterfat Production per Cow from Season to Season.

During the past season nearly 50,000,000 lb. of butterfat beyond that of the previous one were produced, and the average production per cow milked increased by perhaps nearly 20 lb., although the average age of cows was less. This looks to me a wonderful illustration of the effect of a better supply of feed during the season, brought about by the combined influence of climate and the carrying-out of a generous top-dressing programme, and indicates that the quantity and quality of grass has not as yet reached the point of securing anything like maximum returns from our cows. In other words, our cows tend to be better than the feed that is supplied them, and I should judge the same applies to the ewe and the sow. This, to my mind, indicates that the actual feed management in grassland practice is capable of considerable improvement, and being essentially connected with efficiency, is a question on which more definite and reliable data than we possess should prove of value. A difference of 20 lb. per cow now that we are probably milking not less than 1,800,000 cows represents no small figure—over 16,000 tons of butterfat, a plus or minus quantity that so far as production is concerned exceeds any quota restriction that has been suggested; and a difference of 5 per cent. in lambing brought about by better ewe nutrition would mean three-quarters of a million additional lambs.

(2) The Artificial Maintenance of Grassland to a Wet-stock Standard.

Wet-stock standard grassland represents green, rapidly growing, long-season production, broad-leaved grassland; and the great potentially ahead of New Zealand grassland farming is the very large area, running into millions of acres, that is climatically suited to the production of such type of grassland, but from the natural-soil standpoint is unsuitable, and the great development in recent years has been the translation of much of such country from dry-stock to wet-stock standard by the veneering of the surface with a film of phosphate irrespective of the fertility or, rather, lack of fertility, of the soil itself. Nothing perhaps is more striking in New Zealand, where rainfall is well distributed, than the presence of adjoining paddocks, one wet-stock type with its artificial phosphate veneer, and the other soil (nutritionally) dry-stock country, where top-dressing is not carried out. During the past three years the truth of the surface-fertility theory (the artificial phosphate veneer theory) in the maintenance of grassland to a wet-stock standard in high rainfall districts has been wonderfully exemplified in the many thousands of acres of soil nutritionally dry-stock country—pumice country that has been grassed by the Fields Division of the Department in the Rotorua district. Within a single season from the natural scrub-covered condition it has been converted into essentially perennial rye-white clover pasture of high production, permanent, provided the veneer of phosphate is kept renewed, the country is adequately stocked to provide consolidation, and that certified seed has been used. So far as the actual milking-season is concerned, and not taking into consideration the wintering of the stock, such pastures two years old have yielded over 200 lb. of fat per acre, putting them in the front rank of production. Now, particularly in the North Island, there are very large areas of virgin land and very large areas of dry-stock grassland that are capable of similar and rapid response. Probably one of the most difficult questions to determine in New Zealand—with any deliberate slowing-up of production—is just to what degree permanent artificial maintenance of grassland to a wet-stock standard is nationally sound. It is probably the most outstanding grassland problem of the immediate future, but it is nationally economic in character and has little reference to management, which is rapidly becoming standardized on the basis of critically interpreted experience, and is therefore scientifically sound so far as climatically suitable but soil-unsuitable potential wet-stock grassland is concerned.

The position, however, is quite different with respect to climatically unsuitable but, perhaps, soil-suitable wet-stock grassland. Here the artificial factor that must be under control leading to a permanent maintenance of grassland to a wet-stock standard must clearly be irrigation of some sort or another; but on this the economics, the management, and the nationally significant features are none of them in any degree standardized. I view, however, the work being done in the South Island, particularly that in Canterbury, as of very special value concerned as it is with the artificial maintenance of grassland otherwise capable only of maintaining dry stock. Here, however, the veneer must be an intentionally added-water one, while

in the rainfall areas it is a plant-food one; but the essential feature of both is that the application is a surface one—the development point of the renewable rooting system characteristic of wet-stock grassland.

(3) The Development of Seed Certification.

The experience of the past three years would indicate that pasture-seed certification under proper scientific supervision is sound, and the work in New Zealand has attracted world-wide attention from grassland workers. So far as perennial rye-grass goes, it has been spectacular; a few thousand bushels certified three years ago—nearly 300,000 bushels in 1933. Its rapid development has brought marketing troubles, in the solution of which both producer and the seed trade must from the national standpoint work in the closest harmony and co-operation.

Pedigree grazing types of grass and clover seeds, or, shall I say, national mark pasture seeds, the standard under the strictest of scientific control, offers a field for external trade in which New Zealand might well assume leadership.

(4) The Value of Large Numbers of Observational Pasture-treatment Plots.

The value of this work has been amply demonstrated and the trend of effect of lime and potash is being placed in far better perspective. It is possible that soil-survey studies in co-operation with this work may be of very great value in lessening the number of trials and at the same time increasing the practical application that may be derived from them. The value of this work in connection with economic studies as to the practical limits of artificial maintenance of wet-stock standard grassland is of particular significance.

(5) Grass as a Major Factor in Pork-production.

The remarkable results that have been secured by the Waikato Pig-recording Club in a study of the value of pasture grazing in the production of pork make it imperative that this phase of grassland management should be put under intensive study. At the present time we know little, if anything, of the pruning reaction effects of grazing grassland by pigs, and this is a matter that requires close investigation so that standard methods of pig-grazing from the optimum standpoint both of the pig and the pasture may be formulated, and the sow added to the dairy cow and the ewe as an important grass-crop elaborator; one is apt to view the pig with disdain, but can we afford to do so when even now in meat tonnage its export nearly equals a million lambs.

(6) Some Examples of Application becoming Standard immediately following Research.

One of the most distressing features with regard to much research is the time that follows and the difficulties that are experienced in getting research teachings put into practice. During the past two years, however, there have been some remarkable instances to the contrary, amongst which can be mentioned:—

1. Limonite now being used by the truckload in districts where bush sickness has been prevalent, and where it has up to the present largely limited grassland utilization.

2. Over 400 tons of sodium chlorate were used last season in ragwort destruction, and the amount is limited only by the price.

3. Nearly all the lucerne established last season—4,000 to 5,000 acres—has been inoculated with material provided by the Plant Research Station at a cost to the farmer of 1s. per acre.

4. Where perennial rye-grass is required in mixtures in the North Island, certified seed is almost exclusively used.

These examples carry with them important principles which seem to govern the rapid implementing of research into practice. They would look to be three in number :—

1. To impress the farmer that a certain practice is sound by actual illustration under *farm environment.*

2. Simplification to the point that there is no variant or alternative.

3. To provide the essential material or materials in an easily procurable and usable form.

Examples such as these likewise indicate the close connection that should be maintained between research on the one hand and instruction on the other, and the necessity for research to be translatable into what is really practical and not theoretical instruction. One has rather the feeling that grassland research tends to become in its progress too often directed more and more towards the science concerned than to the art into which it must be incorporated if rapid practical translation is to be secured.

THE CONTROL OF MOULD FUNGI IN DAIRY FACTORIES AND MEAT-WORKS.

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One of the first precautions to be taken in the control of moulds on manufactured foodstuffs is to eliminate, as far as possible, sources of infection located on the woodwork and utensils of the factory. The methods commonly adopted for this purpose vary greatly, and little or no experimental evidence is available as to their relative value.

The series of laboratory experiments herein recorded, while necessarily tentative and to be regarded only as preliminary to a more thorough investigation, provide indications which have an immediate practical value. The chief of these is the apparent inefficiency of the widely used chlorine disinfectants as controllants of mould colonies established on woodwork. Formalin gave the best results of the chemicals tried, but, to be effective, it was necessary to allow it to operate in a closed atmosphere and at fairly high concentration. For practical use the most promising indications were given by hot water, applied for as long a time and at as high a temperature as practicable, preferably accompanied by vigorous scrubbing. The experiments also indicated that it is more difficult

to suppress mould colonies established on a rough unplaned surface than it is when the surface is smooth and that the longer established the colonies the more difficult they are to control.

Experimental Method.

Small blocks of unseasoned white-pine timber were used for culturing the moulds. These were smooth planed on top and sides but left rough as sawn at the ends. The blocks were placed on wet pads in petri dishes and, after being sterilized, were inoculated with spores from pure cultures of the various moulds. For series 1 the blocks were incubated for five to six days at 21° C., the colonies being then clearly defined, about 1 in. in diameter, and confined to the point of inoculation on the upper surface of the block. For series 2 the colonies were allowed to develop for from fifteen to eighteen days, having then spread on to all exposed faces of the blocks. Following treatment the blocks were reincubated in sterile petri dishes and examined at intervals up to three weeks. All tests were made at least in duplicate and repeated when not in agreement.

Series 1.—Using Restricted Mould Colonies confined to Upper Surface of Blocks.

Experiment 1.

The moulds used were *Penicillium puberulum*, *Penicillium expansum*, *Cladosporium herbarum*. The solutions used were sodium carbonate, 10 per cent.; trisodium phosphate, 5 per cent.; borax, 5 per cent.; proprietary chlorine sterilizer No. 1; formalin, 1 part of formalin containing 38·5 per cent. formaldehyde to 20 parts of water; soft soap, 5 per cent., alone and in addition to the other materials. Blocks were dipped momentarily, and the colony rubbed with a cotton-wool swab soaked in the solution. The controls were rubbed with cold water only.

The results may be stated as follows: The formalin solution both with and without soft soap completely inhibited renewed sporulation of all three moulds. The borax solution inhibited renewed sporulation of the *Penicillia*, but failed to do so with the *Cladosporium*. Proprietary chlorine sterilizer, sodium carbonate, trisodium phosphate, and soft soap all failed to control the moulds, the two latter, in fact, showing stronger renewed growth and sporulation than blocks rubbed with cold water only.

Experiment 2.

These tests were conducted with the black-spot mould *Cladosporium herbarum* only. This mould is very common on the surface of wood subjected to conditions of high humidity. It has frequently been observed growing and fruiting on the walls, rafters, shelving, vats, &c., of dairy factories and meat-works, and it has been recorded as one of the chief spoilage moulds of unsalted butter(1), and of frozen mutton and chilled beef(2). The hyphæ of this mould have dark walls, and appear to penetrate more deeply into the timber than do the hyphæ

of such moulds as the *Penicillia*, leaving in consequence a dark stain which cannot be rubbed off. The results are indicated in the appended table :—

Blocks dipped momentarily and Colonies rubbed with Swab soaked in the Solution.

Solutions.	Renewed Sporulation in Three Weeks.
Formalin (38·5 per cent. formaldehyde)—	
1 part to 20 parts water	None.
1 part to 50 parts water	None.
1 part to 100 parts water	Delayed and weak.
1 part to 150 parts water	Delayed and weak.
1 part to 200 parts water	Delayed.
1 part to 250 parts water	Mode ate.
1 part to 300 parts water	Vigorous.
Copper sulphate (crystals)—	
2 per cent.	None.
1 per cent.	None.
0·2 per cent.	Weak.
0·1 per cent.	Moderate.
0·02 per cent.	Vigorous.
0·01 per cent.	Vigorous.
Borax 5 per cent.	Delayed and weak.
Boric acid, 5 per cent.	Delayed and weak.
Borax 1 per cent. plus boric acid 4 per cent.	Delayed and weak.
Borax 1 per cent. plus boric acid 3 per cent.	Delayed.
Borax 1 per cent. plus boric acid 2 per cent.	Moderate.
Borax 1 per cent. plus boric acid 1 per cent.	Moderate.
Borax 4 per cent. plus boric acid 1 per cent.	Delayed and weak.
Borax 3 per cent. plus boric acid 1 per cent.	Delayed.
Borax 2 per cent. plus boric acid 1 per cent.	Moderate.
Borax 2 per cent. plus boric acid 3 per cent.	Delayed and weak.
Borax 3 per cent. plus boric acid 2 per cent.	Delayed and weak.
Common salt—	
10 per cent.	Very vigorous.
5 per cent.	Very vigorous.
Saltpetre, 10 per cent.	Very vigorous.
Chlorine compounds—	
Proprietary compound No. 2	Moderate.
Proprietary compound No. 3	Vigorous.
Proprietary compound No. 4	Vigorous.
Eusol (0·4 per cent. chlorine, 1·25 per cent. boric acid)	Vigorous.
Dakin's No. 1 solution (0·5 per cent. chlorine, 0·4 per cent. boric acid)	Vigorous.
Dakin's No. 2 solution (0·5 per cent. chlorine)	Vigorous.

In this experiment renewed growth of the black-spot mould was prevented by formalin at 1 to 20 and 1 to 50 and by copper sulphate at 2 per cent. and 1 per cent. Borax and boric acid gave partial control only. Common salt and saltpetre at 10 per cent. appeared to stimulate the mould. The outstanding result of the experiment was the complete failure of the chlorine disinfectants to control the growth and renewed sporulation of the mould.

Experiment 3.

The object of this experiment was to ascertain the effect of hot water on *Cladosporium herbarum*. Cultures of *Cladosporium* on wood blocks were immersed for 30 seconds in water held at various

temperatures. One block of each duplicate pair was rubbed with a cotton swab while under the water, the other being left undisturbed.

Table of Results of Hot-water Treatment.

Temperature, Fahrenheit.	Renewed Sporulation in Three Weeks.	
	Not Rubbed.	Rubbed.
61°	Vigorous	Delayed, later vigorous.
124°	Vigorous	Delayed, later moderate.
128°	Moderate	Delayed, later slight.
130°	Moderate	Delayed, later slight.
132°	Slight	None.
134°	None	None.
136°	None	None.
138°	None	None.
140°	None	None.
142°	None	None.
144°	None	None.
146°	None	None.
150°	None	None.

These results indicate that thorough washing with hot water is an effective method for the suppression of the black-spot mould when growing on dressed white-pine timber.

Series 2.—Using Diffuse Mould Colonies developed on all Exposed Faces of the Blocks.

Experiment 4.

The object of this experiment was to ascertain the effect of formalin and ammonia in open and closed dishes on *Cladosporium herbarum* and *Penicillium expansum*. Since the previous tests with formalin were carried out in a closed atmosphere only, the following experiment was designed to compare its effect when the treated blocks were freely exposed, thus more nearly representing normal factory practice. A parallel series was also carried out with ammonia, since this has been suggested as a substitute for formalin for the control of moulds in the presence of foodstuffs.

The blocks were immersed momentarily in solutions of formalin and of ammonia, without rubbing, transferred to sterile petri dishes, and incubated for three weeks. Duplicate sets of blocks were used, the dish lid not being replaced for forty-eight hours following treatment with one set and being replaced immediately with the other.

In this experiment neither mould was controlled completely by formalin solution at a strength of 1 to 20 when exposed in open dishes following treatment, although renewed sporulation took place only on the rough surfaces of the blocks. A closed atmosphere is apparently necessary to ensure the full fungicidal effect of formalin. The action of ammonia on the black-spot mould was very similar to that of formalin, though less effective, but it had no apparent effect on the blue mould.

Table of Experimental Results.

Solutions used.	Renewed Sporulation in Three Weeks.			
	Cladosporium herbarum.		*Penicillium expansum.*	
	Open Dish.	Closed Dish.	Open Dish.	Closed Dish.
Formalin 38·5 per cent.—				
1–20 water ..	Trace on ends	None ..	Trace on ends	None.
1–30 water ..	Trace on ends	None ..	Trace on ends	Trace on ends.
1–40 water ..	Moderate ..	Slight ..	Moderate on ends	Slight on ends.
1–50 water ..	Moderate ..	Slight ..	Vigorous ..	Moderate.
1–75 water ..	Vigorous ..	Moderate ..	Vigorous ..	Vigorous.
1–100 water	Vigorous ..	Vigorous ..	Vigorous ..	Vigorous.
Ammonia (specific gravity, 0·882)—				
1–20 water ..	Moderate ..	Trace on ends	Vigorous ..	Vigorous.
1–30 water ..	Vigorous ..	Slight ..	Vigorous ..	Vigorous.
1–40 water ..	Vigorous ..	Slight ..	Vigorous ..	Vigorous.
1–50 water ..	Vigorous ..	Vigorous ..	Vigorous ..	Vigorous.
1–75 water ..	Vigorous ..	Vigorous ..	Vigorous ..	Vigorous.
1–100 water	Vigorous ..	Vigorous ..	Vigorous ..	Vigorous.

Experiment 5.

The object of this experiment was to ascertain the effect of hot water for 5 seconds on colonies of *Cladosporium herbarum.* In experiment 4, above, on the effect of hot water on the black-spot mould, the blocks were dipped for a period of 30 seconds. In the present experiment this period was reduced to 5 seconds, as more nearly representing the time during which the temperature of water used in hosing down could be maintained in contact with the woodwork. The conditions of this experiment also varied in that the mould colonies were older and had become established on the rough ends as well as on the smooth faces of the blocks. A series of temperatures was used, rising by 5° from 140° F. to 195° F., and the colonies were not rubbed.

The results showed that, under these conditions, a water temperature of 185° F., or over, was necessary to prevent renewed growth and sporulation on the rough surfaces. On the smooth surfaces no renewed growth took place following dipping at temperatures of 165° F. or over.

Experiment 6.

The object of this experiment was to ascertain the effect of a steam jet on colonies of *Cladosporium herbarum* and *Penicillium expansum.* A jet of steam from the relief valve of an autoclave at 25 lb. pressure was allowed to impinge for 3 seconds on the surfaces of blocks bearing black-spot mould and blue mould.

The temperature gradient for the steam outward from the point of issue was first ascertained and the blocks held at distances corresponding to differences of 5° F. in temperature. They were then transferred to petri dishes and incubated for three weeks. Four replications were made of each treatment.

The results indicated that at steam temperatures of 165° F. or over no renewed growth took place with either mould when growing on a smooth surface of the block. On the rough ends, however, regrowth took place even after treatment for 3 seconds with steam at 195° F.

General Summary.

Laboratory tests of various materials for the suppression of species of *Cladosporium* and *Penicillium* established on wood showed that the commonly used chlorine disinfectants were ineffective for this purpose.

Copper sulphate and formaldehyde proved effective, but the latter required a closed atmosphere for full efficiency. Hot water accompanied by rubbing gave the best practicable control. The relative roughness of the wood surface and the degree of establishment of the mould colonies materially affected the degree of control obtained.

References.

(1) Morgan, G. F. V., *N.Z. Dept. Agr. Bull.*, 149, 1930.
(2) Brooks, F. T., and Kidd, M. N., Report No. 6, Food Investigation Board, London, 1921.

RETURNS FROM PIG FATTENING ON DAIRY FARMS.

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It has become so customary in New Zealand to consider milk from the point of view of the butterfat it contains that the value of its other solids is too often overlooked or underestimated. On dairy farms practising home separation of milk the sales of cream form the greater part of the revenue. The cream, however, represents about only 10 per cent. of the weight of the milk from which it is produced, and, although it accounts for 97–98 per cent. of the butterfat produced by the herd, there remains in the separated milk a trace of butterfat and the bulk of the non-fatty solids. These solids have a high food value. An average sample of separated milk contains approximately 9·5 per cent. solids. In its liquid form separated milk is not saleable, and the extraction of the solids on the farm is not economically possible. Thus its value to the farmer depends on its optimum utilization as a food for some productive animals, such as pigs, calves, or poultry. Cheesemaking utilizes more of the solids of milk than butter-manufacture. Nevertheless, fully 40 per cent. of the original milk solids passes into the whey, and, although these have a smaller food value than those in the separated milk, they have still quite an appreciable recoverable value when properly utilized.

The Food Value of Separated Milk and Whey.

Purely from a dietetic viewpoint, separated milk is more valuable for growing than fattening animals. Its relatively high content of protein makes it a most useful supplementary food for young animals. As a fattening food it is, theoretically, too rich in proteins, but this

can be corrected easily by feeding with it suitable cereals such as barley, maize, and oats. However, in the dairying districts of the North Island of New Zealand, where these cereals are generally too expensive for conversion into animal products, economic considerations must in practice take precedence to nutritional ideals, and valuable protein substances in milk have to be used for the less valuable purpose, nutritionally, of fattening, since dairy by-products are essentially waste materials in the manufacture of dairy-produce and they are worth only as much as can be made out of them.

The food value of buttermilk, undiluted with water, is much the same as skim-milk. Whey is a less valuable food than either separated milk or buttermilk; it is deficient in protein by reason of the extraction of casein in the cheesemaking process, and it also contains less lime and phosphates than separated milk. Thus, by itself, whey is not a safe food as a sole diet for stock, but its deficiencies can readily be made up by the feeding of a small amount of suitable supplement such as meat-meal with it, and by giving the animals access to good short pasture.

Pigs as Users of Dairy By-products.

Pigs are the most convenient animals for the disposal of these foods. They fatten quickly and their numbers can be fairly easily adjusted to the supply of available by-products by good management. At the present time there is a good demand in Britain for Dominion pig-products, and provision has been made by the British Government for the extension of this trade. In any development of the industry, however, in the dairying districts of New Zealand, it must be recognized that dairy by-products must, under existing economic conditions, form the bulk of the food. It can be shown by calculation that, after making allowance for the upkeep of breeding-stock, about 42 lb. pig-flesh (dead weight) can be produced from the separated milk remaining after extraction of 100 lb. butterfat from whole milk. This figure is practically the same for both baconer and porker production, the smaller feed requirements of the latter per unit of weight increase being offset by the greater sow feed overhead. It can also be shown that there can be produced from the buttermilk resulting from the manufacture of 1 ton of butter, 48 lb. of pig-flesh. The possible returns from whey work out at fully 21 lb. of pig-flesh per 100 lb. butterfat in the milk.

From a farming viewpoint the immediate cash returns from the rational fattening of pigs on unsaleable skim-milk is of material benefit to dairy-farmers. In addition, there are other equally great advantages. Firstly, the pig returns to the farm a considerable amount of manurial residues; it passes off in excreta and urine substances from the milk not used for fattening and growth in a form readily available as fertilizers. Thus, part of the fertility of the farm depleted by the cows is returned by the pigs. Herein lies one of the important points in making the pig area mobile, and ensuring that the whole farm derives benefit from the pig droppings. Secondly, the pig is a soil-improver, not only by virtue of its manure, but also by its consolidation and in some cases tillage efforts. Thirdly, it can utilize grass, thereby providing a means of using feed in places

not of material value to other classes of stock. Fourthly, the price of pig-products is independent of dairy products, and it sometimes happens that a lean year in butterfat prices can be eased by good prices for pigs. Finally, the pig plays an important part in determining farm efficiency, and it is suggested by the data presented herein later that no index of butterfat per acre is satisfactory without a complementary statement of the pig-flesh produced per 100 lb. butterfat.

From a Dominion viewpoint it should be possible to produce from dairy by-products, on the basis of the butter and cheese manufactured in the season 1932–33, approximately 72,500 tons pig-flesh, or fully 1,500,000 carcasses of equal numbers of baconers and porkers.

Actual Production Results on Dairy-farm.

Prompted by the above possibilities, the Manawatu-Oroua Pig Recording and Development Club conducted a farm survey of the results obtained from pig-fattening on a number of farms in the Manawatu district in the dairying season 1932–33. The material to follow represents the results of the survey, which was conducted with the object of (*a*) obtaining reliable data upon the present position of pig-raising in relation to dairying in the Manawatu district, and (*b*) obtaining information of practices yielding the best results.

Collection of Data.

The co-operation of a large number of interested farmers was enlisted, some sixty farms in all being covered in the survey. Of these only eleven were found suitable for the purposes required, and form the basis of this analysis. The remainder were unable to furnish sufficient detailed information. The results obtained should be regarded as representing the best farms available, being farmed by keen men.

Records were collected of the total weight of pig-flesh produced in terms of dead weight, allowance being made at estimated weights for pigs carried over from the previous season, pigs on hand at end of season, and pigs purchased; of the number of sows carried and pigs reared on the farm; of the farm area and the total amount of butterfat produced; of the number of cows milked and calves reared; and of the amounts and types of supplementary pig-feed used. Each farm was visited by the recording officer when necessary during the season and every care taken to verify all data.

Method of Statement of Results.

Returns from pig-fattening in relation to dairying may be stated in several ways:—

(*a*) The production of pig-flesh per 100 lb. butterfat.

(*b*) The production of pig-flesh per cow.

(*c*) The production of pig-flesh per acre.

(*d*) The gross cash returns per pound of butterfat and per cow with pig-flesh at varying prices.

(*e*) The cash returns per pound of butterfat and per cow, deducting the cost of purchased foodstuffs, with pig-flesh at varying prices.

All these indices have been used in the following analysis. For the purpose of comparing relative efficiencies of pig management it is suggested that "pig-flesh per 100 lb. butterfat" is the best single index available. On the average dairy-farm the function of the pig is not to consume the produce of the land, but to consume the produce of the cow. An index, therefore, which expresses the production of the pig in terms of the production of the cow is logically sound. On these grounds "production of pig-flesh per acre" is ruled out, while at first sight "production of pig-flesh per cow" might be considered of equal value to the index selected. It will be shown later, however, that unless considered in relation to the butterfat yield per cow, "pig-flesh per cow" is not as significant a measure of pig-management efficiency as "pig-flesh per 100 lb. butterfat." "Gross cash returns" and "Cash returns over meal costs" have also obvious defects, since they are governed largely by market price fluctuations.

Types of Farms.

All the farms covered practised home separation, the skim-milk produced being fed to calves and pigs. They represent a wide range of farm area—from 31 acres to 428 acres (Table 2) and of cows milked—from 20 to 300. The majority, however, range from 50 to 100 acres and from 30 to 60 cows. Though the number is small, they are in respect of cow numbers and farm area fairly typical of dairy-farms of the district.

Results obtained.

(*a*) *Average Returns.*

Table 1 summarizes the position in respect of the eleven farms.

Table 1.—Summary of Pig-production Figures.

Number of Farms.	Number of Cows.	Number of Acres.	Butterfat produced.	Pig-flesh produced.	Pig-flesh per 100 lb. Butterfat.	Pig-flesh per Cow.	Pig-flesh per Acre.	Calves per 100 lb. Butterfat.
			lb.	lb.	lb.	lb.	lb.	
11 ..	755	1,142	180,230	62,968	34·9	83·4	55·1	0·1

	lb.
Highest yield pig-flesh per 100 lb. butterfat ..	48·0 + 0·083 calves.
Lowest yield pig-flesh per 100 lb. butterfat ..	22·0 + 0·087 calves.
Highest yield pig-flesh per cow	136·6
Lowest yield pig-flesh per cow	55·8
Highest yield pig-flesh per acre	88·3.
Lowest yield pig-flesh per acre	33·5.

	Pig-flesh per 100 lb. Butterfat. lb.	Pig-flesh per Cow. lb.
Highest ratio sows to cows 1 : 5	43·8	131·3
Lowest ratio sows to cows 1 : 16	22·0	58·3
Highest yield average butterfat per cow—300 lb. ..	45·5	136·6
Lowest yield average butterfat per cow—201 lb. ..	27·7	55·8

Highest gross return with pork at 4d. per pound—£2 5s. 6d. per cow; 1·92d. per pound butterfat.

Lowest gross return with pork at 4d. per pound—18s. 7d. per cow; 0·88d. per pound butterfat.

It will be seen that a total of 180,230 lb. of butterfat and 62,968 lb. of pig-flesh was produced, representing an average production of 34·9 lb.

of pig-flesh per 100 lb. of butterfat, 83·4 lb. per cow, and 55·1 lb. per acre. In addition, an average of one calf per 1,000 lb. of butterfat was reared. Valuing this production at 4d. per pound of pig-flesh, the average gross return from pig-raising was 1·4d. per pound of butterfat and £1 7s. 9d. per cow.

(*b*) *Individual Returns.*

Comparisons between the best and the worst farms indicate that wide differences occurred (Table 1). The production of pig-flesh on the worst farm per 100 lb. of butterfat was 22 lb. and on the best 48 lb., the proportion of calves reared being roughly the same in each case. This represented a difference of approximately 120 per cent. The margin on a per-cow basis was even greater—from 55·8 lb. to 136·6 lb., or a difference of 143 per cent., and greater still on a per-acre basis—from 33·5 lb. in the lowest to 88·3 lb. in the highest, or a difference of 163 per cent. On a valuation basis, the significance of these differences is apparent. With pig-flesh at 4d. per pound the gross cash returns varied from 1·92d. per pound of butterfat and £2 5s. 6d. per cow on the best farms to 0·88d. per pound of butterfat and 18s. 7d. per cow on the worst.

Table 2 sets out the production figures of the indivudual farms in greater detail.

Table 2.—Showing Pig-flesh Production Figures of the Individual Farms per 100 lb. Butterfat per Cow and per Acre in relation to the Production of Butterfat.

Farm Letter.	Pig-flesh per 100 lb. Butterfat.	Pig-flesh per Cow.	Pig-flesh per Acre.	Number of Calves per 100 lb. Butterfat.	Butterfat per Cow.	Butterfat per Acre.	Size of Farm.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	lb.	lb.	lb.		lb.	lb.	Acres.
H ..	48·0	134·2	88·3	0·083	280	184	79
I ..	45·5	136·6	88·1	0·033	300	194	31
C ..	43·8	131·3	73·0	0·133	300	167	81
E ..	43·5	97·2	60·7	0·080	223	140	136
K ..	40·6	104·6	67·6	0·122	260	167	48
L ..	40·1	113·7	79·3	0·000	283	198	86
D ..	38·3	87·2	72·8	0·080	228	198	31
A ..	36·8	97·2	61·5	0·000	264	167	60
J ..	28·3	74·4	48·5	0·083	262	171	49
F ..	27·7	55·8	39·1	0·154	201	141	428
G ..	22·0	58·3	33·5	0·087	265	152	113

While the differences between the highest and the lowest farms are very great, six farms of the eleven produced over 40 lb. of pig-flesh per 100 lb. butterfat and five over 100 lb. per cow. Of the remainder only three have yielded relatively low returns, and, on these, production has been at about the same level. When it is remembered that many farms make no use whatever of dairy by-products, even these latter figures cannot be considered really poor results; all have produced very good returns. It will be noted that the figures of the best farms closely approximate that suggested as being theoretically obtainable.

In Table 2 the farms are arranged in order of "pig-flesh per 100 lb. butterfat." It will be noted that high production of pig-flesh in terms

of butterfat is associated generally with similar high production per cow and per acre. Farms with a production of 40 lb. and over per 100 lb. of butterfat all show over 100 lb. of pig-flesh per cow, while farms with a production of less than 40 lb. per 100 lb. of butterfat have all yielded less than 100 lb. per cow. The relationship is not absolute, however, as can be seen from farms E and A, which have produced the same amount of pig-flesh per cow (97·2 lb.), and yet different yields on a butterfat basis (43·5 lb. and 36·8 lb.). Similarly, the production of pig-flesh per cow of farms E, K, and L is in inverse order to that of their production per 100 lb. of butterfat. To a lesser degree this applies also as between farms H and I and farms F and G. Examination of column 5 (Table 2) suggests that differences in the production of butterfat per cow are responsible for these anomalies, and indicates that high production of pig-flesh per cow is not significant unless related to the production of butterfat per cow.

Factors in Pig Management contributing to High Production.

(*a*) *Butterfat per Acre.*

In increasing returns from the dairy-farm, farmers have been urged to aim at a high yield of butterfat per acre. It is claimed that this should be accompanied by a statement of good returns from the utilization of by-products such as a high yield of pig-flesh per 100 lb. of butterfat. In urging the importance of increasing pig production along with butterfat production, the relationship between the two indices should be noted. Since the major foodstuff used for pig production on the dairy-farm is skim-milk, the value "pig-flesh per 100 lb. of butterfat," assuming full and efficient utilization, should be relatively constant. Differences in "pig-flesh per 100 lb. butterfat" must be attributed to differences in efficiency of pig management or by-product utilization.

If high production of butterfat per acre is an index of efficient land utilization, and if pig-flesh per 100 lb. butterfat denotes efficiency of by-product utilization, the expression "butterfat per acre plus pig-flesh per 100 lb. butterfat" provides a convenient means of stating relative efficiency of dairy-farm production. Since pig-flesh per 100 lb. butterfat should be relatively constant the yield of pig-flesh per acre should be directly proportional to the butterfat production per acre; an increase in the latter should be accompanied by a proportionate increase in the former. While Table 2 shows a general relationship between butterfat per acre and pig-flesh per acre, high yields of both tending to be associated, indicating good management in one direction to be reflected in both, the relationship is not as above, since pig-flesh per 100 lb. butterfat has varied. Farms C and D, in illustrating this point, show also that "pig-flesh per acre" is unsatisfactory as an index of pig management unless considered in relation to "butterfat per acre." On these farms equal production of pig-flesh per acre has been obtained, but efficiency of production has not been the same, since farm D has a much greater yield of butterfat to the acre—a difference shown immediately by the pig-flesh per 100 lb. butterfat index.

(*b*) *Butterfat Yield per Cow.*

Columns 1, 2, and 5 (Table 2) show the relationship between pig-flesh per 100 lb. butterfat and per cow, and the average yield of

butterfat per cow. High butterfat average per cow is considered to be a measure of efficient cow management in dairying. Providing wide differences in test are not operating, the amount of skim-milk available should be roughly proportional to the butterfat yield per cow, and high yields of the latter should accordingly be reflected in high yields of pig-flesh per cow, and, if pigs are managed with equal efficiency, in high yield per 100 lb. butterfat. Fawcett's survey* suggests such a relationship, his figures based on cash returns showing that high cash returns from pigs are associated with high herd averages, indicating that efficiency in one direction is reflected in both. It is frequently stated, however, that the opposite is the case: that farms characterized by high butterfat averages per cow often show poorer pig returns than others due to differences in the emphasis of management, such farms concentrating on cow production at the expense of pig production. The figures referred to above provide evidence in support of both statements, indicating—

(1) *That where high production of pig-flesh is obtained it generally accompanies a high yield of butterfat per cow.* Thus the four best farms—I, C, H, L—on a pig-flesh per 100 lb. butterfat and per-cow basis have the highest average yield of butterfat per cow, ranging from 280 lb. to 300 lb.

(2) *That a high yield of pig-flesh does not necessarily accompany a high yield of butterfat per cow.* Thus Farm G has produced only 22 lb. of pig-flesh per 100 lb. butterfat and only 58·3 lb. per cow, although the average yield of butterfat per cow was 265 lb.

(3) *That a low yield of pig-flesh does not necessarily accompany a low yield of butterfat per cow.* Thus Farm E produced 43·5 lb. of pig-flesh per 100 lb. butterfat and 97·2 lb. per cow, although the average yield of butterfat per cow was only 223 lb.

(4) *That while a higher yield of pig-flesh per cow is generally produced where the yield of butterfat per cow is high, the increase is not necessarily proportional to the increase in butterfat yield—e.g.,* farms E, K, L. While L has the highest yield of butterfat per cow and pig-flesh per cow it has the lowest yield of pig-flesh per 100 lb. butterfat.

These relationships indicate that, while high returns from pigs tend to be associated with high returns from cows, the amount of by-products available is not the principal factor involved; that some farmers make far better use of their by-products than others. They emphasize the importance of the management factor in securing good results, and that interest in the pig department of the farm plays a big part in efficient by-product utilization.

(*c*) *Ratio of Sows to Cows.*

Table 3 sets out the ratio of number of sows carried to cows milked on each farm, together with the number of pigs reared per sow and the proportion of store pigs bought.

Comparing these figures with the relative production of pig-flesh per 100 lb. butterfat, it will be seen that farms which have produced at a high level have carried more sows to cows milked than farms

* Fawcett (1929): *New Zealand Department of Agriculture, Bulletin No. 138,* p. 37.

Table 3.—Showing the Ratio of Sows to Cows, Number of Pigs reared per Sow, Proportion of Pigs purchased, and the purchased Concentrates used, in relation to the Production of Pig-flesh per 100 lb. of Butterfat.

Farm Letter.	Pig-flesh per 100 lb. Butterfat.	Ratio Sows : Cows.	Number of Pigs purchased as Percentage of Number sold.	Number of Pigs reared per Sow.	Total Meals used.	Meals per 100 lb. Pig-flesh.
	(1)	(2)	(3)	(4)	(5)	(6)
	lb.				lb.	lb.
H ..	48·0	1 : 7	..	14·1	400	5·7
I ..	45·5	1 : 10	..	17·5	300	11·0
C ..	43·8	1 : 5	..	12·2	3,976	67·0
E ..	43·5	1 : 14	30	12·0	898	10·8
K ..	40·6	1 : 8	..	10·0	..	..
L ..	40·1	1 : 12	..	11·0	2,000	29·3
D ..	38·3	1 : 9	9	13·0	925	39·0
A ..	36·8	1 : 13	..	13·0	..	..
J ..	28·3	1 : 11	47	8·3	..	..
G ..	22·0	1 : 16	..	12·0	340	9·0

producing at a low level. The type of trade pursued—whether the pigs are carried to porker or baconer weights—will, of course, affect the number of sows carried. The wide ratio of farm E is apparently compensated for by the purchase of over 30 per cent. of the total pigs fattened. Farm I has a good production, but a fairly wide ratio, but the number of pigs reared per sow is greater than on any other farm. This would tend to offset the apparent disadvantage of a small number of sows to cows.

As would be expected, the number of pigs reared per sow evidently plays a part in high production, a narrow ratio of sows to cows combined with a large number of pigs reared tending to be associated with the best returns. Thus, although farm J has a ratio of 1 : 11 and in addition purchased 47 per cent. of the pigs fattened, relatively low production figures were obtained. This farm reared only 8·3 pigs per sow, compared with the best farm 17·5 pigs per sow. Compared with farm E, which has a wider ratio of sows (1 : 14) and a smaller proportion of purchased pigs, farm J should have produced better returns than it did. The smaller number of pigs reared, combined with the fact that the purchased pigs of J failed to thrive satisfactorily—23 per cent. of them dying—probably accounts in part for the difference.

The table suggests also that the sow-cow ratio is a possible factor in the case of farms E, K, L previously mentioned, and influenced the relatively lower yield of L.

(*d*) *Type of Trade.*

The production of porkers and weaners is usually stated to result in a greater production of pig-flesh than the production of pigs of bacon weight, due to the greater economy of food consumption of the lighter-weight pigs. This general statement is open to question on the grounds that it does not make due allowance for the heavier sow overhead associated with the production of pigs of light weights. Theoretical considerations previously mentioned suggest that the latter factor at least compensates for the former. In practice the

type or combination of types of trade followed is governed largely by the necessity for effecting as close a correlation as possible of feed requirements, types, and numbers of pigs with fluctuating seasonal milk-supplies, and by the additional factor of price of weaners in relation to the price of pork and bacon.

Table 4 sets out the relative production of bacon, pork, and weaners and stores of each farm.

Table 4.—Relationship between the Type of Trade practised and the Production of Pig-flesh per 100 lb. Butterfat.

Farm Letter.	Type of Trade as Percentage of Total Production of Pig-flesh.			Pig-flesh per 100 lb. Butterfat.
	Bacon.	Pork.	Weaners and Stores.	
				lb.
H	41	35	24	48·0
I	..	88	22	45·5
C	32	27	41	43·8
E	58	34	8	43·5
K	46	40	14	40·6
L	87	13	..	40·1
D	27	50	23	38·3
A	..	100	..	36·8
J	13	87	..	28·3
G	60	30	10	22·0

As far as the figures go, there seems no obvious relationship between the type of trade and the pig-flesh to 100 lb. fat index. It is interesting to note, however, that, with the exception of one farm, all have practised a mixed type of trade, combining at least two and in most cases all three methods. Averaging the figures of all farms producing above and those producing below 40 lb. pig-flesh per 100 lb. butterfat shows that, contrary to the popular conception, the greatest returns have been obtained where bacon trade has predominated and the lowest where pork production played the most important part. The comparison is made on too few farms to be significant, however, and is complicated by the evidence that the lower producing farms have not utilized their skim-milk to the best advantage.

(*e*) *Purchased Supplementary Foods used.*

Table 3 (column 6) shows the amounts of purchased meals used on the respective farms per 100 lb. of pig-flesh produced. It is noteworthy that good returns have been obtained on these farms with but little assistance from purchased meals, a fact of considerable importance to the pig industry in view of the price of meals for pig-fattening in dairying districts. It is noteworthy, too, that all of the best farms have used some meals, though the quantities employed were very small. Farm C has been by far the largest concentrate feeder, yet even here the amount has been relatively low, amounting to only 2 tons over a total production of 5,918 lb. of pig-flesh, or 67 lb. of meal per 100 lb. of pig-flesh. This farm carried the greatest proportion of sows to cows —1 : 5. Farms A and K are interesting in showing good results without the use of any purchased meals.

(*f*) *Size of Farm.*

On the number of farms available there seems no significant relationship between the size of the farm and the production of pig-flesh per 100 lb. butterfat (Table 2). Six most efficient farms, producing over 40 lb. per 100 lb. butterfat, ranged from 31 acres to 136 acres in area. The least efficient production was obtained from an area not substantially different from the area yielding the most efficient production. On a per-acre basis, too, there seems no correlation, the larger areas comparing favourably with the smaller.

Gross Cash Returns with Pig-flesh at varying Prices.

Tables 5A and 5B set out the gross cash returns of each farm on a butterfat and a per-cow basis respectively, valuing the pig-flesh produced at varying prices of 3d., 4d., and 5d. per pound. The figures show not only the revenue which it is possible to derive from pig-raising on the dairy-farm, but also the effect upon gross cash returns of different levels of production.

Table 5A.—Gross Cash Returns per Pound of Butterfat with Pig-flesh at varying Prices.

Farm Letter.	Pig-flesh per 100 lb. Butterfat.	Pig-flesh at 3d. per Pound.	Pig-flesh at 4d. per Pound.	Pig-flesh at 5d. per Pound.
	lb.	d.	d.	d.
H	48·0	1·44	1·92	2·40
I	45·5	1·36	1·82	2·28
C	43·8	1·32	1·75	2·19
E	43·5	1·31	1·74	2·18
K	40·6	1·22	1·62	2·03
L	40·1	1·20	1·60	2·01
D	38·3	1·15	1·53	1·92
A	36·8	1·10	1·47	1·84
J	28·3	0·85	1·13	1·42
F	27·7	0·83	1·11	1·39
G	22·0	0·66	0·88	1·10

On a butterfat basis the returns vary by considerable amounts—from 1·92d. per pound to 1·53d. per pound on the seven best farms, and from 1·47d. to 0·88d. per pound on the four worst farms, with pig-flesh at 4d. per pound. The gross returns per pound of butterfat of the three best farms are practically double those of the three worst.

Table 5B.—Gross Cash Returns per Cow with Pig-flesh at varying Prices.

Farm Letter.	Pig-flesh per Cow.	Pig-flesh at 3d. per Pound.	Pig-flesh at 4d. per Pound.	Pig-flesh at 5d. per Pound.
	lb.	£ s. d.	£ s. d.	£ s. d.
I	136·6	1 14 2	2 5 6	2 16 10
H	134·2	1 13 7	2 4 9	2 15 11
C	131·3	1 12 10	2 3 9	2 14 8½
L	113·7	1 8 5	1 17 11	2 7 4½
K	104·6	1 6 2	1 14 10½	2 3 7
E	97·2	1 4 3½	1 12 5	2 0 6
A	97·2	1 4 3½	1 12 5	2 0 6
D	87·2	1 1 9½	1 9 1	1 16 4
J	84·4	0 14 7	1 4 9½	1 11 0
G	58·3	0 14 7	0 19 5	1 4 3½
F	55·8	0 13 11½	0 18 7	1 3 3

Cash returns from pigs are often stated on a per-cow basis, though, as already stated, a butterfat basis is more informative. At 4d. per pound the gross cash returns per cow have varied from £2 5s. 6d. to £1 14s. 10d. on the farms yielding over 100 lb. of pig-flesh per cow and from £1 12s. 5d. to only 18s. 7d. where the yield has been less than 100 lb. of pig-flesh per cow.

Cash Returns over Meal Costs.

If the cash outlay involved in the purchase of meals to supplement skim-milk be deducted from gross cash returns, the figures obtained will more closely represent the net value of the by-products used. Table 6 shows the net cash returns over meal costs on the different farms, based on meals at a flat rate of £9 per ton and pig-flesh at 4d. per pound.

Table 6.—Cash Returns over Meal Costs with Pig-flesh at 4d. per Pound and Meals at £9 per Ton.

Farm Letter.	Gross Cash Returns.	Cash Returns over Meal Costs.		Per Pound of Butterfat.
		Total.	Per Cow.	
	£ s. d.	£ s. d.	£ s. d.	d.
H	116 16 8	114 14 8	2 4 1½	1·9
I	45 0 8	43 16 7	2 3 10	1·75
E	137 15 4	134 3 4	1 11 5	1·69
K	54 1 8	54 1 8	1 14 10½	1·62
L	113 14 0	105 12 9	1 15 2	1·49
C	98 12 8	82 13 2	1 16 8	1·47
A	61 11 4	61 11 4	1 12 5	1·47
D	39 5 9	35 11 0	1 6 4	1·38
J	39 13 4	39 13 4	1 4 9½	1·13
G	63 3 4	61 16 1	0 19 0	0·86

These figures show, first, that pigs have contributed considerable revenue on most farms, and, secondly, that this has been done at little meal cost. With the exception of farm C, which holds third place in gross returns (Table 5A), but only sixth place when meal costs are deducted (column 4 above) due to the heavier rate of supplementary feeding on this farm, the deduction of the cost of meals has made little difference to the cash-return figures. It must be noted, too, that, while meals have been charged at a flat rate of £9 per ton, the actual cost was in most cases lower than this.

The figures of column 4, representing the cash returns per pound of butterfat are significant, and indicate that under good management the utilization of by-products by pigs can make a substantial contribution toward the farm dairy returns. Seven farms show a return of from 1½d. to 2d. per pound of butterfat. If the average price of butterfat for the 1932–33 season be placed at 10d., 2d. per pound of butterfat from raising pigs represents a 20-per-cent. increase on butterfat returns over the farm which makes no use of dairy by-products. The argument can be carried even further. Most will agree that the cost of butterfat-production is at least 8d. per pound. The greater part of the returns from pig-fattening on separated milk represents profit. Where the farmer is receiving, say, 9d. per pound for butterfat—a price

probably greater than will be received during the present season—and is producing ½ lb. of pig-flesh per pound of butterfat, he is making a greater net return from his separated milk than he is from his butterfat.

Summary.

(1) Figures are presented showing the position of pig-raising in relation to dairying on eleven Manawatu dairy-farms during the 1932–33 dairying season. The figures can be considered to represent the best of sixty farms.

(2) The production of "pig-flesh per 100 lb. of butterfat" is suggested as the best single index available for comparing relative efficiencies of pig management as a means of utilizing dairy by-products on the dairy-farm.

(3) The most efficient farm shows a return of over 48 lb. of pig-flesh per 100 lb. of butterfat, but it is suggested that it is quite practicable to obtain at least 40 lb. of pig-flesh per 100 lb. of butterfat on the average on the home-separation dairy-farm.

(4) The production of pig-flesh on the dairy-farm can be increased by the use of meals, but the economy of such practice is dependent upon relative costs.

(5) Relationships between the production of pig-flesh and the production of butterfat indicate—

(*a*) Increase in the production of butterfat per acre should be accompanied by increase in pig production:

(*b*) Increase in the production of butterfat per cow should be accompanied by increase in pig production:

(*c*) Land improvement, cow improvement, and pig improvement should go hand in hand.

(6) It is quite practicable for the Dominion to expand the export of pig-flesh even if pig prices are low, for pigs, properly managed, utilize the dairy by-products which otherwise go to waste.

(7) The results presented show dairy-farmers can materially restrain the effects of falling prices for butterfat by the careful breeding, feeding, and management of pigs. Under the low prices for dairy produce now operating, separated milk efficiently utilized will yield a greater net return to the farmer than will butterfat.

In conclusion the writer would like to take this opportunity of thanking all those farmers who co-operated with the Manawatu-Oroua Pig Recording and Development Club in supplying the information for this analysis. In particular, thanks are due to Mr. W. J. Croucher, Pig Recording Officer, who was responsible for the collection of the data on the farms.

Compensation paid for Stock and Meat condemned.—Compensation to the amount of £6,780 was paid out during the year ended 31st March last for animals condemned in the field for disease under the provisions of the Stock Act, and £10,581 for carcasses, or parts of carcasses, condemned for disease on examination at the time of slaughter at abattoirs, meat-export slaughterhouses, &c., under the provisions of the Slaughtering and Inspection Act.

THE METHOD OF PREPARING AND PACKING APPLES AND PEARS FOR EXPORT.

A. T. DOUGLAS, Orchard Instructor, Nelson.*

IT is desired to impress on all exporters of apples and pears the desirability and necessity of having their fruit handled with every possible care from the time picking operations commence until the fruit is outside their control.

CARE IN PICKING.

Commencing with the operation of picking, one of the first things a picker should look to both at the start and during the day's work is the cleanliness of the picking bag, apron, or receptacle in use, as the collection of dirt and small twigs in the bag is liable to puncture and scratch the fruit. Fruit that is accidentally dropped on to the ground should be left there and not picked up and put into the picking-bag. The actual operation of picking is quite simple if adequate care is taken. The fruit should be picked so that the stem is intact and still adhering to the apple. This can usually be accomplished by taking the fruit in the palm of the hand, and by lifting the fruit upwards it will usually come away from the tree quite easily. If the fruit is pulled off there is always the possibility of breaking the skin or fracturing the tissues at the base of the stalk. Rots very frequently develop as a result of these injuries.

After the fruit is picked it should be placed gently into the bag or apron, which should not be filled too full. It is much better to empty the picking bag or apron into the orchard case frequently than to wait until it is overflowing before emptying. When emptying the picking-apron into the orchard case exercise as much care as possible, as bruising may take place if the fruit is emptied out roughly. Lower the apron down into the case before releasing the fruit and break the fall with the hands as much as possible. Do not stand almost upright and release the fruit with a rush; but bend the body to the desired extent to permit the fruit to roll gently into the case.

The orchard cases should not be overfilled, especially if a double tier is being carried on the conveyance to the packing-shed. The fruit in the cases should be levelled off to prevent the second tier from riding on the fruit beneath. The extra care and time taken to see that no fruit is projecting above the top of the cases would avoid damage to the fruit from this cause. The use of a cover or tarpaulin over the load also helps to keep the fruit firm, especially if the ground traversed is at all bumpy.

PRECAUTIONS IN PACKING.

On delivery to the packing-shed, the fruit passes into the hands of the graders, whose duty it is to sort out the fruit into the respective grades according to the standard requirements laid down, and place the fruits on the belt or conveyers which carry them to their respective bins in readiness for packing. Simultaneously, fruit which is below

* Substance of a lecturette broadcast from Station 2YA.

the required standards must be eliminated as rejects. The usual practice followed in grading is to tip the fruit from the orchard cases on to the grading-table. The table should not be overloaded, for such a practice may cause bruising and stem puncture. The correct method is to have a gradual supply of fruit going on to the grading-belts, as this obviates the necessity for the persons grading to hold the belts stationary until the bulk of the fruit on an overloaded table is disposed of.

As practically the whole of the pip fruits which are exported from the Dominion are passed for sizing purposes over mechanical graders of various types, a word of advice to growers at this stage concerning the cleanliness of their grading-machines would not be out of place. The grading-machine should be put in thorough mechanical working-order prior to the commencement of the season. It should be stripped and thoroughly scrubbed and cleaned during the off season, as much damage can be done by dirty rollers or belts, especially to the tender-skinned varieties of fruits in the early part of the season when much scratching of the skin can occur from this cause. During the season a periodical wipe-down of rollers, belts, and bins to remove dirt particles also helps considerably.

One of the main causes of fruit being damaged by stem punctures is the practice of packers pulling the fruit down in the bins and allowing bins to become too full. The damage is caused during the pulling-down process—that is, scooping the fruit which is dropping from the fruit-conveyers forward towards the front of the bin, the stem of one fruit punctures the skin of another fruit, and the injury can easily pass unnoticed during the process of packing, but has a disastrous effect on the fruit and is the cause of considerable waste.

The process of packing fruit is an art unto itself. When the packer commences work the fruit has already passed over the grader, and has been graded according to standard requirements, and has also been sized as nearly correctly as a mechanical grader can be expected to size fruits of various shapes. As very few of the mechanical graders size accurately, a good deal of responsibility rests with the packer to place wrongly sized fruits in their proper bins, and to throw out any undergrade or reject fruits which have inadvertently been missed by the persons who are grading. A packer will on an average pack neatly from eighty to one hundred cases per day.

Three grades are set down in the standard requirements for export in the coloured varieties of apples—namely, Extra Fancy, Fancy, and Good grades—and two in the yellow or green varieties—namely, Extra Fancy and Fancy, each variety and grade with varying allowances of colour, russet, blemish, &c. These grades may be packed according to size into approximately as many as fifteen separate counts..

In the past the sizes allowed for export have varied from $3\frac{1}{2}$ in. fruit down to $2\frac{1}{8}$ in. fruit. The Canadian standard case with an inside measurement of $10\frac{1}{2}$ in. by $11\frac{1}{2}$ in. by 18 in. is the only type of case used for apples. The pack used is known as the diagonal pocket pack. In this pack three distinct styles are used—namely, the 2 by 2 pack, the 3 by 2 pack, and the 3 by 3 pack. In this way each apple, if properly placed, rests in a pocket between two apples in the layer below, hence the name "pocket pack." No fruit should be so placed as to cause it to rest directly on top of another

fruit in any direction. By this method the fruit is kept firm and is prevented from moving about in the case during handling in transit, with the result that little bruising should occur.

The 2 by 2 pack is used for large-sized fruit up to $3\frac{1}{4}$ in. in diameter, the 3 by 2 is for medium-sized fruit from 3 in. in diameter to $2\frac{5}{8}$ in. in diameter, and the 3 by 3 pack is for fruit $2\frac{1}{2}$ in. to $2\frac{1}{8}$ in. in diameter.

To obtain a well-packed case of fruit with the requisite amount of bulge on the top and bottom of the case, to ensure a full and firm pack, and to obtain what is known as a "crown pack," the following routine should be adopted by packers: The fruit must first be properly wrapped; this means that the whole of the fruit must be covered by the paper wrapper; each individual fruit must be placed in its proper position with the stalks of the fruit facing to one end of the case, as this obviates stem punctures; each fruit must be placed in the case either with the calyx or with the stalk end of the fruit square on to the end of the case. On no account should the fruits be placed on an angle, as this makes the fruit in the layer too tight and allows no pocket for the fruit in the tier above to rest in; it also makes the pack too solid, and will not allow the fruit to give and fit snugly into the pockets. Extensive bruising is caused by angling the fruit, and in most cases it causes the pack to be too high, thereby causing bruising when the lid is brought into position for nailing down.

During packing each alternate layer should receive a slight pressure from the hands of the packer at the two ends of the layer only. On no account should pressure be exerted on the centre of the layer. By applying this pressure on the two ends of the layers a crown is formed, and when the case leaves the packer's hands the fruit at the end of the layers should be no more than $\frac{1}{2}$ in. above the top of the case, while the fruit at the centre should be about $1\frac{1}{2}$ in. higher than the case.

Some variation is noticeable in the tightness of the various types of packs used, and a good deal of discretion on the part of the packer must be used to ensure that no bruising will take place through faulty packing. It is noticeable that in the case of the tighter packs such as 96, 163, 175, and 252, some packers do not use enough discretion, and make the bulge in these packs as high as in the packs with more open pockets. This should not be so, as these packs being more compact and with smaller pockets should be $\frac{1}{2}$ in. lower both at the ends and centres of the case as compared with the looser packs.

In the majority of packing-sheds to-day, lidding is done by means of a press worked by exerting pressure on a foot lever after the case has been placed in position, causing two horizontal arms to swing in a forward and downward motion, and thereby holding the lid in position for the nailing of the cleats and lid on to the case. The person responsible for this operation should exercise every care to see that there is no danger of fruit at the ends or sides of the case being cut during the actual operation of applying pressure to the lid. It is also advisable for the person who is actually doing

the job to place both hands and exert his weight downwards on the centre of the lid at the same time as the pressure is being applied to the lid by the arms of the lidding press.

In conclusion, although attention has been directed to a number of faults which occur in the packing of fruit, with a view to bringing about a further improvement in regard to more careful handling, it is only right to state that a large number of growers and packers put up their fruit in a careful and attractive manner. In some instances, however, sufficient care is not taken, and this helps to spoil the reputation of all our growers, and for that reason all should try to handle their fruit with the greatest care and endeavour to maintain a high standard for New Zealand fruit on the markets overseas.

POTATO-MANURING EXPERIMENTS.

INVESTIGATIONS INTO THE EFFECT OF WIDTH OF PLOTS ON YIELD DETERMINATION.

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Prior to the 1930–31 season about sixty potato-manuring experiments conducted by the Department of Agriculture during the preceding six years consisted of frequently replicated plots each three rows in width. It is a well-established principle that, for a given area under experiment, the use of small plots frequently replicated will result in a more accurate determination of yield and smaller associated errors than if the same area is covered by larger plots less frequently replicated. It is assumed, of course, that plots would not be reduced in size to an extent which would cause competition between plots, &c., to introduce errors which would invalidate the results from each individual plot. Alternatively, the same degree of precision in the measurement of yields and differences may be obtained from a smaller total area of relatively smaller and more frequently replicated plots as from some greater area in larger and less frequently replicated ones. By adopting a suitable arrangement of the former a reduction is possible in the field-work and expense entailed, because of the less amount of crop to be handled, without loss of precision.

The experiments described below were carried out with the object of determining whether or not the adoption of single-row plots, which would materially reduce the work involved compared with large plots, would result in unduly large real errors. At the same time, it was possible to get some idea of the errors introduced by assessing yields from all rows as opposed to using the middle rows only, in three-row plots.

Description of Experiments and Technique.

The 1929–30 and 1930–31 trials were conducted on the property of Mr. W. J. Crozier, and in 1931–32 on Mr. W. A. McPhail's, both at Mitcham, Mid-Canterbury.

The soil probably falls in the fine sandy silt or fine sandy loam class, being very friable and overlying shingle at a depth of a few feet. It is representative of a good deal of the lighter potato-growing soils of Canterbury.

The rainfall averages about 25 in. per annum. Dry conditions were experienced during the growing period of the crops, especially in 1930–31 and 1931–32.

The treatments under trial were as follows in hundredweights per acre :—

		Cwt.
O	= no manure.	
P	= superphosphate (20·2 per cent. P_2O_5)	3
PN	= super 3 cwt., sulphate of ammonia 1 cwt.	4
PNK	= super 3 cwt., sulphate of ammonia 1 cwt., sulphate of potash 1 cwt.	5
PK	= super 3 cwt., sulphate of potash 1 cwt.	4

For convenience the treatments will be referred to as O, P, PN, PNK, PK.

Each plot was three rows in width (rows 30 in. apart) in each experiment. In the 1929–30 experiment each plot was 2 chains and in 1930–31 and 1931–32 1 chain in length.

There were ten replications of each treatment in the 1929–30 experiment, the order being as under :—

Five replications.	Five replications.
&c., PK, PNK, PN, P, O.	O, P, PN, PNK, PK, &c.

In 1930–31 and 1931–32 each experiment was laid down in two series, there being twenty replications of each treatment as under :—

Five replications.	Five replications.
&c., O, P, PN, PNK, PK	PK, PNK, PN, P, O, &c.
&c., PK, PNK, PN, P, O	O, P, PN, PNK, PK, &c.

The above arrangement was adopted with the object of reducing the influence of any fertility slope which might be present.

Fertilizers were applied by hand along the line in the bottom of the furrow occupied by the potato sets. In order to ensure as uniform a distribution as is possible by hand, the fertilizer for each row was weighed out separately and applied in the first instance as uniformly as possible, but at a rate below that necessary. The balance was then spread evenly over the quantity already applied.

Digging was done by hand, each row being divided into $\frac{1}{2}$-chain lengths for convenience of handling, and weighed to the nearest $\frac{1}{10}$ lb. Sorting into table, seed, and small grades was done in the process of picking up the potatoes, standards being agreed on beforehand. Care was taken to avoid individual bias which might result if one individual picked up one particular plot-row or treatment and another individual some other, throughout the trial.

"Student's" method of comparing paired plots was used in computing the statistical significance of the results presented in Tables 1 and 2.

Table 1.—Effects of Manures estimated from Yields (a) of Middle Rows only, (b) of all Three Rows, in Hundredweights per Acre and Yields of No Manure (O).

Estimated from	1929–30 Season.				1930–31 Season.				1931–32 Season.				Average of Three Seasons.			
	Table.	Seed.	Small.	Total.	Table.	Seed.	Small.	Total.	Table.	Seed.	Small.	Total.	Table.	Seed.	Small.	Total.
Effect of P—																
Differences of P from O (a) Middle rows	5·8	**5·3**	**7·2**	**18·3**	**−5·1**	**6·9**	**8·4**	**10·2**	**11·5**	**10·4**	**5·2**	**27·1**	4·1	7·5	6·9	18·5
Differences of P from O (b) All three rows	**9·4**	**5·9**	**6·2**	**21·5**	−1·1	**5·6**	**8·9**	**13·4**	**15·1**	**11·3**	**6·1**	**32·5**	7·8	7·6	7·1	22·5
Effect of N—																
Differences of PN from P (a) Middle rows	**29·4**	**10·3**	**6·8**	**46·5**	−0·8	**4·4**	**10·8**	**14·4**	**7·9**	2·8	**5·8**	**16·5**	12·2	5·8	7·8	25·8
Differences of PN from P (b) All three rows	**25·5**	**9·1**	**7·1**	**41·7**	**−3·4**	**5·0**	**11·6**	**13·2**	**8·4**	1·0	**5·1**	**14·5**	10·2	5·0	7·9	23·1
Differences of PNK from PK (a) Middle rows	**38·0**	**6·2**	**5·7**	**49·9**	−0·9	**6·7**	**12·8**	**18·6**	**12·0**	2·7	3·1	**17·8**	16·4	5·2	7·2	28·8
Differences of PNK from PK (b) All three rows	**34·5**	**6·9**	**6·3**	**47·7**	−0·7	**7·7**	**13·4**	**20·4**	**11·2**	1·8	**2·8**	**15·8**	15·0	5·5	7·5	28·0
Effect of K—																
Differences of PK from P (a) Middle rows	0·3	1·9	0·3	2·5	**8·6**	−1·6	−2·6	4·4	2·8	−0·4	0·7	3·1	3·9	0·0	−0·5	3·3
Differences of PK from P (b) All three rows	−0·8	2·3	0·5	2·0	**6·4**	−1·1	−2·9	2·4	0·6	−1·0	0·5	0·1	2·1	0·1	−0·6	1·5
Differences of PNK from PN (a) Middle rows	**8·9**	**−2·3**	−0·7	**5·9**	**8·5**	0·7	−0·6	**8·6**	**6·8**	−0·5	−2·0	4·3	8·1	−0·7	−1·1	6·3
Differences of PNK from PN (b) All three rows	**8·1**	0·2	−0·3	**8·0**	**9·1**	1·5	−1·1	**9·5**	3·4	−0·3	−1·8	1·3	6·9	0·5	−1·1	6·3
Yields of O (a) Middle rows	69·0	33·0	15·7	117·7	50·9	35·9	29·4	116·2	62·7	20·9	10·5	94·1	60·9	29·9	18·5	109·3
Yields of O (b) All three rows	68·6	33·0	16·6	118·2	49·2	36·2	29·6	115·0	60·9	21·2	10·1	92·2	59·6	30·1	18·8	108·5

Table 2.—Comparison of Yields from Side Rows with those from Middle Rows of Three-row Plots of each Treatment.

Treatment.	Comparison.	Hundredweights per Acre. 1929–30.				1930–31.				1931–32.				Average of Three Seasons.			
		Table.	Seed.	Small.	Total.	Table.	Seed.	Small.	Total.	Table.	Seed.	Small.	Total.	Table.	Seed.	Small.	Total.
	Difference of side row next to—																
O (having P plots on one side and PK on the other)	P from middle row	−2·7	0·6	2·2	0·1	−4·0	0·7	0·1	−3·2	−2·1	0·4	−1·0	−2·7	−2·9	0·6	0·4	−1·9
	PK from middle row	0·6	0·9	0·4	1·9	−2·1	0·3	0·2	−1·6	−3·9	0·5	−0·2	−3·6	−1·8	0·6	0·1	−1·1
P (having O plots on one side and PN on the other)	O from middle row	**7·6**	2·0	−1·5	**8·1**	**4·7**	−0·7	1·5	**5·5**	**6·1**	1·7	0·4	**8·2**	6·1	1·0	0·1	7·2
	PN from middle row	2·1	−0·3	1·1	2·9	2·3	−2·2	0·4	0·5	−0·9	1·9	1·1	2·1	1·2	−0·2	0·9	1·8
PN (having P plots on one side and PKN on the other)	P from middle row	−1·8	0·4	1·7	0·3	−0·1	0·3	2·4	**2·6**	4·5	−1·8	−0·3	2·4	0·9	−0·4	1·3	1·8
	PNK from middle row	0·1	−2·5	−1·2	−3·6	−0·6	−1·2	1·9	0·1	1·9	0·0	−0·4	1·5	0·5	−1·2	0·1	−0·6
PNK (having PN plots on one side and PK on the other)	PN from middle row	−3·7	2·7	1·8	0·8	0·0	−0·2	3·2	**3·0**	−4·2	1·0	0·7	−2·5	−2·6	1·2	1·9	0·5
	PK from middle row	−0·2	2·7	0·0	2·5	1·2	1·9	−0·3	2·8	0·4	−2·0	−0·8	−2·4	0·5	0·9	−0·4	1·0
PK (having O plots on one side and PNK on the other)	O from middle row	**7·5**	1·8	−0·8	**8·5**	0·4	0·1	2·3	2·8	0·9	−0·3	0·9	1·5	2·9	0·5	0·8	4·2
	PNK from middle row	1·1	1·0	−0·2	1·9	0·2	−2·2	−0·1	−2·1	−1·6	1·9	0·1	0·4	−0·1	0·2	−0·1	0·0

Figures in heavy type represent statistically significant differences: Odds greater than 30 to 1.

Discussion of Table 1.

In Table 1 the effects of the various fertilizers on the yields of the various grades are estimated from (*a*) middle rows only, (*b*) all three rows. (The actual yields of the no-manure treatments are shown at the foot of the table.)

On the assumption that the yields of the middle rows are not influenced to an appreciable extent by competition between plots of different treatments, the comparison between the effects of the fertilizers estimated from the yields of the middle rows on the one hand and from all three rows on the other provides a measure of the errors introduced by the latter method of estimation.

Effect of P.—Estimating the yields from all three rows has resulted in an overestimate of the effect of superphosphate on the yield of table grade potatoes in all three experiments. The yields of seed and small grades are very similar under both systems of estimation. (The reason for the overestimate is made apparent in Table 2.) As a result, the error in estimation of total yield is about the same as that of yields of the table grade.

Effect of N.—It is only in the 1929–30 season that a marked discrepancy occurs, between the two systems of determining the differences in yield so far as the treatments receiving nitrogen are concerned. It will be seen from Table 2 that this is due not so much to differences between the middle and side rows of the nitrogen-treated plots as to errors associated with the estimate of yields from all three rows of the P and PK plots from which the differences of PN and PNK respectively are estimated.

In relation to the actual increases in yield the discrepancy is not a great one, however.

Effect of K.—There is reasonable agreement, on the average, between effects of K estimated from middle rows only or from all three rows, the biggest difference occurring in the third season.

Discussion of Table 2.

The comparison of side rows of the three-row plots with middle rows provides a measure of how errors in yields estimated from all three rows have arisen.

Treatment O.—Both side rows of O (next to P on one side and PK on the other) have, with one exception, slightly lower yields of table grade than the middle row, although none of the differences is statistically significant. It is certain, therefore, that the side rows have not derived any benefit from the adjoining manured rows of the P and PK plots. On the contrary, they appear to have suffered to a small extent from the competition of the more vigorous growth of the P and PK plots. To what extent root competition occurred was not determined, but the growth of tops was invariably more vigorous on all the manured plots than on those not receiving manure.

Treatment P.—Comparison of side row next to O with the middle row of this treatment (P) shows that the former is significantly better in yield of table potatoes and in total yield in each of the three seasons. Obviously this is due to the less vigorous growth of the plants on the adjoining O treatment.

To what extent the lesser growth of the tops of the plants on the O treatment, allowing more light to and better development of the tops of the outside row of P treatment, and to what extent less root competition from the O treatment may have been responsible for the differences recorded, it is impossible to say.

All fertilizer treatments increased the growth of the tops, and, broadly speaking, the treatments including nitrogen (PN and PNK) were very nearly as much superior to P and PK in their effect on the growth of tops as P and PK were superior to O. If, then, the greater yield of the side row of P next to O was due solely to a better development of the tops, a somewhat similar result from the side rows of PN next to P and of PNK next to PK should have occurred. Table 2 and the graph indicate that on the average of all seasons this did not occur appreciably in either case. It seems justifiable to conclude therefore that the side rows of P next to O benefited primarily because they were subjected to less root competition than the middle rows and the side rows next to PN, each of the latter being in competition on both their sides with rows receiving the same amounts of superphosphate as they received themselves.

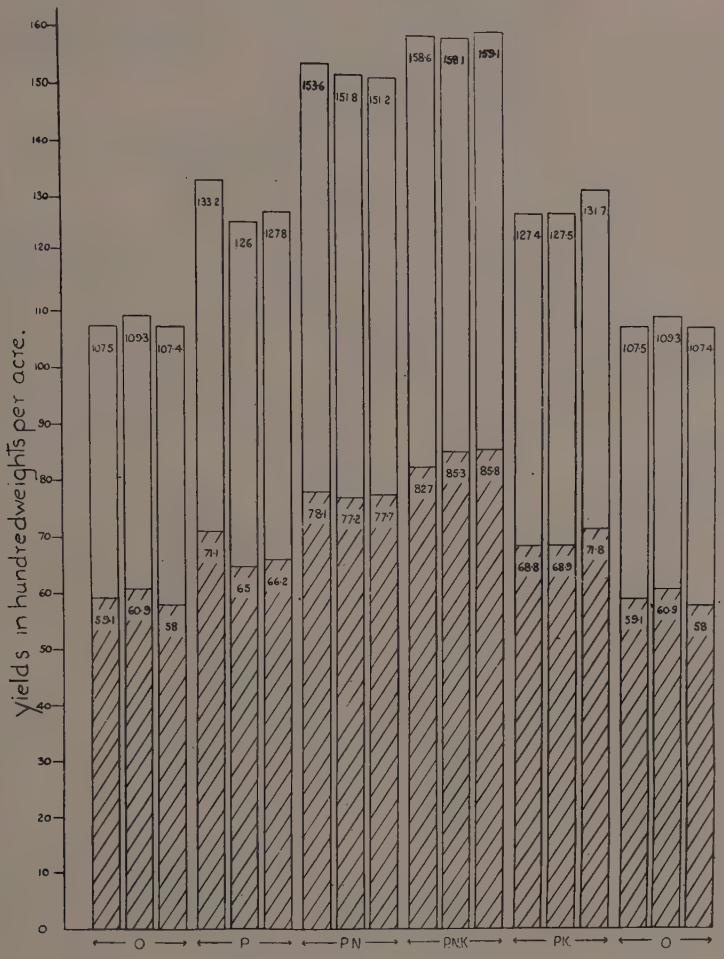
There are no significant differences between the middle rows and the side rows of P next to PN.

Treatments PN and PNK.—The only statistically significant differences between middle- and side-row yields occurred in the 1930–31 season, when the total yields of each of the PN and PNK treatments were affected, the small grade of potatoes contributing almost entirely to the differences in the total yields. On the average of the three seasons the differences between middle row and side rows were small.

As mentioned above, PN and PNK treatments increased the growth of tops very appreciably over P and PK, the former being only slightly different from one another in appearance. In the 1929–30 season PN appeared slightly bigger in top growth than PNK, the reverse applying in 1930–31 and 1931–32.

Treatment PK.—In the 1929–30 season the side row of PK next to O behaved, relative to its middle row, in almost exactly the same way as the corresponding rows of P. Subsequently, however, differences were small and not significant.

The different behaviour of this treatment from that receiving P only in the 1930–31 and 1931–32 seasons is of interest, as it would seem logical, in view of the very slight differences in their appearances, to expect their individual rows to behave similarly. The following is suggested as a possible explanation of their not doing so. In 1930–31 the growth of tops on the PK treatment was, about ten weeks after planting, slightly inferior to that on P. (This retarding effect of potash on early growth has been observed in other experiments.) This retardation of top growth would undoubtedly be accompanied by a retarding of root growth, and it is possible that the extra development of the root system which it is suggested occurred on the side row of P next to O did not occur, to the same extent at any rate, in the corresponding row of PK. It should be noted, however, that no retardation due to potash was noticed in the 1931–32 season, whereas, if anything, potash improved top growth a little. No differences between P and PK plots were observable in 1929–30.



Graph showing yields of individual rows (averages of three experiments). The diagonally-shaded portions represent yields of *table* potatoes. Full columns represent total yields. See discussion on Table 2.

Summary and Conclusions.

Three experiments on the manuring of potatoes, in which O, P, PN, PNK, and PK treatments were replicated from ten to twenty times in three-row plots, are described. Each row was weighed separately with the object of determining the effects of competition between outside rows of adjoining treatments and the differences in yield between middle and side rows of each treatment.

The soil under trial responded to applications of superphosphate and sulphate of ammonia and to a lesser extent to sulphate of potash, but, in the case of the latter, more particularly when used in conjunction with P and N.

The object of the investigation was to determine whether or not the adoption of single-row plots, which would materially reduce the work involved compared with larger plots, would result in unduly large

real errors. At the same time, it was possible to get some idea of the errors introduced by assessing yields from all rows as opposed to using the middle rows only in three-row plots.

The following tentative conclusions are drawn :—

(1) Side rows of no-manure plots alongside rows receiving P or PK did not differ significantly from the middle row or derive any benefit from the manure on the adjoining rows.

(2) Side rows of P plots next to O gave significantly greater yields than their middle rows. Side rows of P plots next to PN did not differ significantly from their middle rows. Estimating yields from P treatment situated alongside O from all rows in three-row plots resulted in an overestimation of the effect of the phosphate. Single-row plots would result in a greater overestimate.

(3) Side rows of PN plots alongside P on one side and PNK on the other did not differ appreciably from their middle rows, with one minor exception.

(4) Side rows of PNK plots alongside PN on one side and PK on the other did not differ appreciably from their middle rows, with one minor exception.

(5) Side rows of PK plots alongside O differed from the middle row in one experiment, but not appreciably in the other two. Side rows of PK plots next to PNK did not differ from their middle rows to any appreciable extent.

(6) From the fact that the treatments receiving nitrogen were approximately as superior in top growth to P and PK as P and PK were to O, it is suggested that rows of P next to O were at an advantage compared with other rows of this treatment, primarily because of less root competition. The failure of side rows of PK next to O, which were very similar in appearance to corresponding rows of P, to conform in all seasons to the behaviour of P is discussed.

(7) The results indicate that single-row plots for the comparison of treatments all of which receive a basal dressing of phosphate should be reasonably satisfactory, but that where phosphate is being tried against no manure on a soil responsive to phosphate, plots should contain at least three rows, and the outside rows should be disregarded in yield determinations. It must be recognized that the effect of potash was slight in these trials, and that, given a soil more responsive to this fertilizer, the behaviour of side rows relative to middle ones may have been different.

(8) Although these results indicate that assessing yield from all rows of three-row plots, as was done in the general programme of experiment up to the 1930–31 season, results in an overestimate of the effect of superphosphate when plots with this fertilizer are placed alongside no-manure plots, it is considered that such errors as have occurred are of no consequence for the following reasons :—

(*a*) The average increase due to superphosphate at 3 cwt. per acre in thirty-six experiments in which the super was alongside no manure was 18 cwt. of table potatoes and 5 cwt. of seed.

(*b*) Since 3 cwt. of super costs about 15s. and it requires only 5 cwt. of table potatoes at 3s. per hundredweight to meet the cost of fertilizer, there is still a big margin for profit even allowing for larger errors than were shown to occur in the experiments discussed in this article.

The thanks of the Department are extended to Messrs. Crozier and McPhail for their valuable assistance in the conduct of these trials.

PASTURE TOP-DRESSING IN OTAGO AND SOUTHLAND.

EXPERIMENTAL WORK BY THE FIELDS DIVISION.

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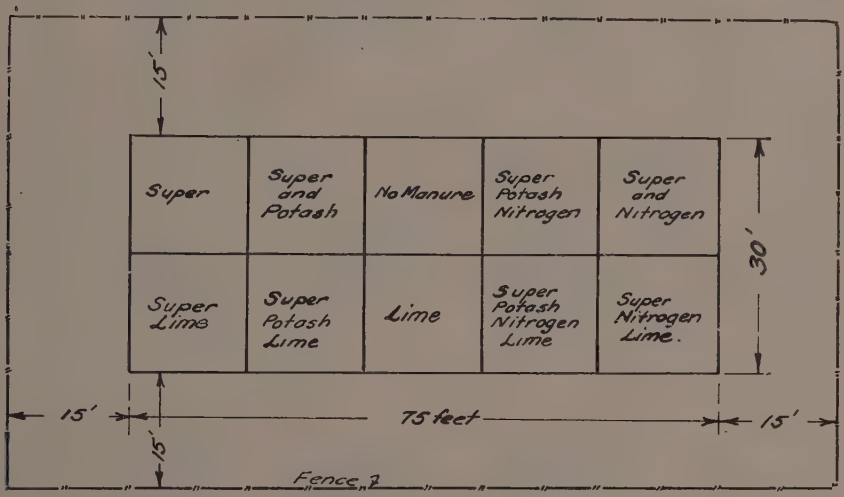
IN the spring of 1929, forty observational top-dressing experiments were laid down throughout Otago and Southland, and these were followed by thirty-five additional experiments of a slightly different layout in the following year. In each succeeding season further experiments have been laid down either to replace those discontinued from various causes or to extend the investigation, but it is proposed in this article to deal only with the above seventy-five which have now reached a stage where the various manurial effects can be gauged.

The original plots were laid down according to the accompanying plan (Fig. 1):—



PLOT A Under Controlled Grazing.

Super	Super and Potash	No Manure	Super Potash Nitrogen	Super and Nitrogen
Super and Lime	Super Potash Lime	Lime	Super Potash Nitrogen Lime.	Super Nitrogen Lime.

PLOT B Under Ordinary Grazing.

FIG. 1 PLAN OF GRASS OBSERVATIONAL PLOTS: DUPLICATE PLOTS LAID DOWN ADJACENT TO EACH OTHER.

NOTE.—Lime applied at the rate of one ton per acre.

The following season, owing to difficulty experienced by the co-operating farmer in the utilization of the controlled areas, stock were allowed free access to both areas, the fences being removed. In regard to the 1930 plots their layout was that as shown in Fig. 2.

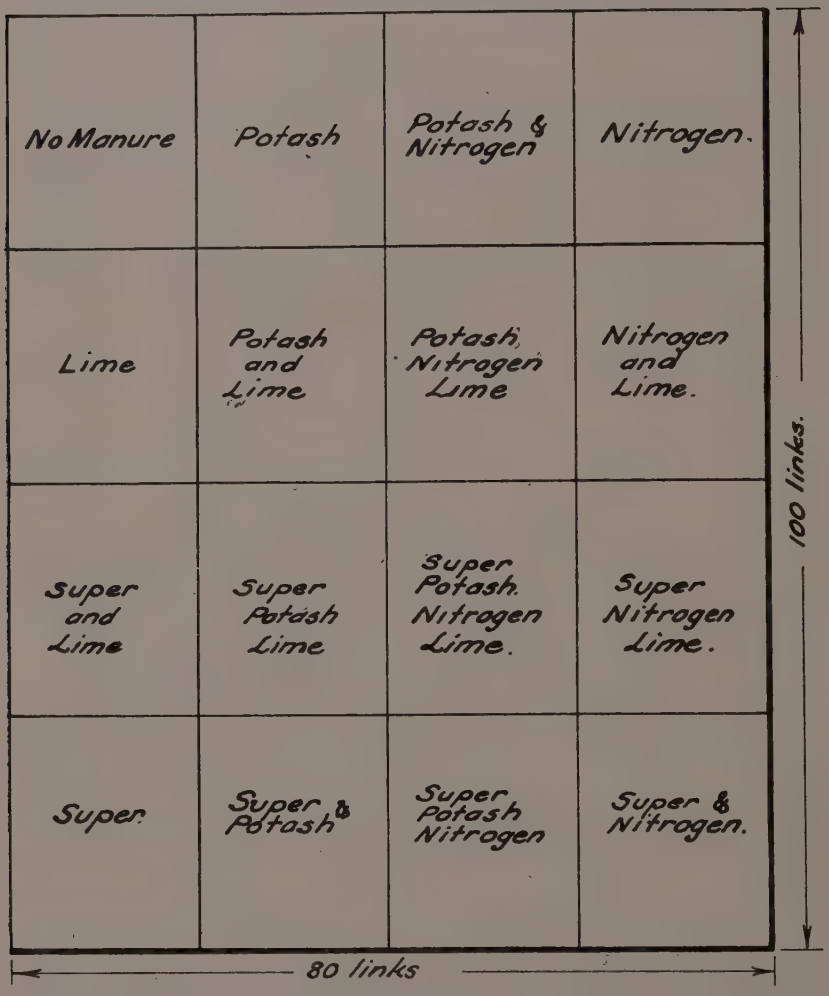


FIG. 2. PLAN OF PASTURE TOP-DRESSING EXPERIMENT (OBSERVATIONAL L.P.K.N. SERIES).

NOTE.—Lime applied at the rate of one ton per acre.

The treatments were applied to the plots in the autumn and spring at the following rates: (1) Carbonate of lime, 1 ton per acre (first year only); (2) superphosphate, 3 cwt. per acre; (3) potash salts (30 per cent.), 2 cwt. per acre; (4) sulphate of ammonia, 1 cwt. per acre.

In various localities, particularly in Southland, additional plots adjacent to the above series were treated with 3 cwt. per acre of basic slag. No further applications of lime were made until the autumn of 1932, when an additional 5 cwt. per acre was applied to those plots still being continued. Autumn applications of superphosphate and potash

salts, in most cases at the same rate as the initial applications, were made yearly. Sulphate of ammonia was applied twice per annum, generally during July–August and March–April.

Summary of Results.

The results of each individual experiment are summarized in Table 1, which also groups the experiments according to the instructorate in which they were laid down. A key to the figures employed in pointing or indicating the effects is as follows: 0 = No visible response. ? = Doubtful response. 1 = Slight response. 2 = Fair response. 3 = Good response. 4 = Very good response. 5 = Excellent response.

Table 1.—Showing Responses to Lime and Manures on Individual Farms.

Reference No. on Map and Farmer's Name and Address.	Lime.	Super.	Lime + Super.	Basic Slag.	Potash.	Nitrogen Spring.	Nitrogen Autumn.
Central Otago Instructorate.							
*1. R. Gartly, Springvale	?	4	4	..	0	4	2
*2. J. C. Sanders, Little Valley	?	3	3	..	0	3	1
*3. J. Muir, Galloway	0	0	0	..	0	4	1
4. J. D. Williams, Hawea Flat	?	2	2	..	?	2	1
*5. T. Smith, Queensbury	0	2	2	..	0	4	1
6. D. Roberts, Sutton	0	4	4	..	0	4	1
7. J. E. O'Connell, Frankton	?	1	1	..	?	2	1
8. T. H. Mee, Becks	?	3	3	..	0	2	1
9. A. Grant, Lower Shotover	1	1	1	..	1	1	?
South Otago Instructorate.							
10. D. McGregor, Milburn	0	3	3	..	0	3	2
11. I. M. Smollett, Awamangu	1	2	2	3	0	3	2
12. McCaw Bros., Forsyth	1	2	3	..	0	1	1
13. E. Skinner, Waitahuna	1	2	3	..	0	2	1
14. A. J. Lunan, Murray's Flat	1	1	1	..	0	2	1
15. P. Bathgate, Allanton	?	2	2	..	0	2	2
16. G. Donaldson, Highcliff	1	2	2	..	?	2	1
17. W. Kirk, Mosgiel	0	2	2	..	0	2	2
18. Gunther Bros., Milton	2	0	2	..	0	1	1
19. T. Bishop, Bishops	0	2	2	2	0	1	1
20. G. Stewart, Warepa	0	3	3	..	0	4	0
21. W. R. Gorman, Owaka	2	0	2	..	0	2	1
22. W. Stiven, Paretai	0	1	1	..	0	1	1
23. G. Muir, Upper Junction	1	2	2	..	0	1	1
24. J. D. Walker, Otokia	0	0	0	..	0	0	0
25. W. Bradfield, Tahatika	1	2	3	..	0	3	2
26. J. B. Morris, Owaka Valley	2	1	3	..	2	3	2
27. J. Christie and Sons, Warepa	1	2	3	..	0	3	1
North Otago Instructorate.							
28. G. Simpson, Kia Ora	0	1	1	..	0	2	0
29. J. Newlands, Ngapara	?	1	1	..	0	1	0
30. J. Hannan, Oamaru	0	1	1	..	0	1	0
31. W. McMillan, Herbert	1	1	2	..	0	2	0
32. J. Aitchison, Hillgrove	2	1	3	..	0	1	0
33. J. Grant, Awamoa	1	0	1	..	0	1	0
34. J. Rae, Kauru Hill	0	0	1	..	0	1	0
35. H. S. Sheat, Bushey	1	1	2	..	0	2	1
36. A. G. Mitchell, Kakanui	1	1	2	..	0	1	0
37. J. G. Williamson, Bortons	0	0	0	..	0	2	0
38. G. D. Hunter, Pukeuri	0	0	0	..	0	1	0
39. A. E. Austin, Five Forks	0	0	0	..	0	1	0
40. R. M. Williamsom, Five Forks	0	0	0	..	0	1	0

Table 1.—Showing Responses to Lime and Manures on Individual Farms—continued.

Reference No. on Map and Farmer's Name and Address.	Lime.	Super.	Lime + Super.	Basic Slag.	Potash.	Nitrogen Spring.	Nitrogen Autumn.
Eastern Southland Instructorate.							
41. F. Kane, Glenkenich	1	2	3	..	0	2	1
42. J. F. Herbert, Heriot	1	1	2	..	0	2	1
43. G. McBryde, Charlton	2	3	3	..	4	3	1
44. A. R. Johnston, Waikaka Valley ..	2	2	3	..	0	3	1
45. S. Morrison, Waikaka Valley	3	1	4	..	0	3	2
46. D. Dun, East Chatton	2	2	3	..	0	2	1
47. H. Smith, Waikaka Valley	1	2	3	..	2	4	2
48. R. Knibbs, McNab	3	2	4	..	2	2	2
49. A. Byars, Knapdale	1	3	4	..	2	3	1
50. E. Smith, Edendale	1	2	4	4	4	2	1
51. G. Irwin, Mataura	2	2	3	..	2	3	2
52. R. K. Dodds, Charlton	3	2	4	..	1	3	2
53. J. Cowie, Balfour	1	2	2	..	1	2	1
54. E. W. Stevens, Balfour	1	1	2	..	0	..	..
55. D. McDonald, Balfour	3	3	4	..	4	3	2
56. W. Mortimer, Waipounamu	3	3	5	..	2	3	2
57. W. Fowler, Wendon	1	2	3	..	1	3	2
Western Southland Instructorate.							
58. Evans Bros., Longbush	3	3	4	4	3	3	3
59. A. Horne, Morton Mains	3	3	4	3	3	4	3
60. W. Barron, Morton Mains	0	3	3	3	0	3	3
61. A. S. McNaught, Rakahouka	0	3	3	3	4	3	3
62. G. McKay, Hedgehope	2	2	3	2	2	2	2
63. D. McKenzie, Otapiri	0	3	3	4	3	3	2
64. W. G. Hartley, Ryal Bush	0	2	2	2	?	2	2
65. D. McPherson, Waianiwa	0	3	3	2	4	3	3
66. R. Sim, Otahuti	0	2	2	2	2	2	2
67. C. Brown, Waimatuku	?	3	3	3	?	3	?
68. D. McRae and Sons, Dipton	2	3	3	3	4	4	3
69. A. P. Lindsay, Waimatuku	3	3	3	4	0	3	?
70. C. Saunders, Woodlands	0	1	1	1	?	2	2
71. A. Robinson, Hedgehope	3	3	4	4	0	2	0
72. O. Neiderer, Gorge Road	0	3	3	2	?	3	0
73. R. E. Monteath, Gorge Road	0	3	3	1	0	3	0
74. L. King, Rakahouka	0	3	3	2	0	3	0
75. A. T. Drain, Awarua Plains	2	2	3	2	?	2	0

Comments on Table 1.

In Central Otago the best results have followed from the use of superphosphate, and also from the additional spring application of sulphate of ammonia. The experiments marked with an * denote those laid down on irrigated land, and it will be noted that Experiments 3 and 5, both of which were laid down on rye-grass (dominant) and white clover swards, have given very good results only to the spring applications of sulphate of ammonia. This result was obtained during the period in which irrigation was not practised. Poor results were experienced from Experiments 7 and 9, due to the poor quality of the pasture on these soil-types.

In South Otago the best results have been obtained from the application of lime plus superphosphate, closely followed by applications of

superphosphate alone. A spring application of sulphate of ammonia has been found beneficial. Very poor responses have resulted from the application of manures and lime on the Taieri Plain as exemplified in Experiments 15, 17, and 24. Very few of the remainder were originally laid down on first-class pasture or soil.

Exceptionally poor results have been obtained in the North Otago district, but it should be borne in mind that this district has experienced droughty conditions over the greater part of the period under review. Slight responses have marked the use of superphosphate and lime, and the spring application of sulphate of ammonia. Nevertheless, after allowing for the conditions experienced, it would appear that in this locality water becomes the limiting factor to pasture growth.

The best results in Eastern Southland have been obtained from lime and superphosphate both alone and in combination. The number of experiments which indicated a potash response is high, and it would appear that further investigations as to the value of potash would be warranted. Spring applications of sulphate of ammonia also gave beneficial results, while the responses obtained from the autumn application were superior to those obtained in other districts.

In Western Southland basic slag responses were practically on a par with those obtained from lime and superphosphate. Very good results were obtained from the application of potash, particularly in Experiments 61, 65, and 68. The lack of response to lime alone in quite a number of experiments probably is accounted for by the fact that sufficient lime had already been supplied in a district where the general farming practice is to sow down to grass with one ton of carbonate of lime.

It will be noticed that in Southland as a whole the response to both spring and autumn applications of sulphate of ammonia was much greater than in Otago, and this is probably due to the heavier rainfall conditions prevailing.

It is to be particularly noted that invariably the responses coincided with the class of pasture to which the fertilizers were applied. Brown-top dominant pastures gave little or no response, whereas good mixed pastures of a dominant rye-white clover content invariably responded to treatment. The outcome of these observational experiments leads one to the conclusion that whilst phosphates predominate in importance as a top-dressing fertilizer, sulphate of ammonia and potash, particularly in Southland, give responses that fully merit further attention and investigation being devoted to the use of these two fertilizers. The ability of potash, particularly in conjunction with phosphate, to promote a denser sward in certain localities and the efficacy of sulphate of ammonia to invigorate early growth are features which must be commented upon.

Thanks are due to the various farmers co-operating in these trials, and acknowledgment has to be made of the painstaking and constant observations made by the various field officers throughout Otago and Southland.

In a Poverty Bay permanent pasture, which has wintered eight sheep an acre, the percentage of cover contributed by the various pasture species was: Perennial rye-grass, 67·5; white clover, 23·5; goose-grass, 6·8; burr clover, 1·2; various, 1.

SOME PARASITES OF OUR DOMESTIC LIVE-STOCK.

THEIR LIFE-HISTORIES AND DISEASE-PRODUCING CAPABILITIES.

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There are a very large number of parasites to be found in and on our sheep, cows, horses, dogs, cats, poultry, &c., some comparatively harmless in themselves, but potential carriers of more serious diseases, and others, directly harmful, offering damage to the meat, hides, or even the life of their hosts. Children at school are taught the life-histories of flies and moths, the life-cycles of which are comparatively complicated and of general interest. Many of the animal parasites get into most unusual places in the animal body before finally becoming adult and their life-stories are even more interesting.

The chief kinds of parasites found externally are flies, lice, ticks, mange, fleas, and, within the body, flat worms or flukes, tapeworms, and roundworms.

"Swat that fly" sums up the general feeling of insecurity felt by all of us when we see the house-fly or the blow-fly on our food after parading on any available manure-heap, and the ubiquitous house-fly is a grave danger when we have disease epidemics to contend with. Important as is the common fly, there are other flies more dangerous as carriers of disease. Tropical countries possess carriers of sleeping sickness, malaria, and various other diseases of stock and man, but, fortunately, in New Zealand we have not the dangerous diseases of the tropics.

External Parasites.

What farmer does not know the bot-fly of the horse. Two species are common here, and their life-cycles are similar. The eggs are commonly seen cemented to the hair of the legs or to the under lip. With saliva the eggs hatch out and the larva passes into the mouth, but, instead of going on down to the stomach, it burrows through the lining of the mouth and then on down the gullet as far as the stomach, where it again burrows out. In the stomach it grows until it becomes about an inch in length and remains in that position attached by a pair of hooks for nearly nine months. At the end of that time the larva lets go and passes out in the fæces, burrows into the ground, pupates, and later hatches out into the adult male or female fly. A little kerosene rubbed on the legs while the eggs are fresh will end this cycle at its commencement.

The nasal bot of sheep is now suspected of being implicated in that brain disease of sheep known as "circling disease." The fly lays its larvæ on the nostrils of sheep, and these larvæ travel into the sinuses of the head. There they live throughout the winter. It is thought that they irritate the sinuses and allow the entry of a germ which grows in the brain.

* Substance of a lecturette broadcast from Station 2YA.

Warble flies have a curious method of becoming adult. The egg is laid on the skin of the legs or over the shoulders of cattle. This process terrorizes cattle, and they gallop madly about to escape the fly. Later the developing larva burrows under the skin and about the body until it reaches a position below the skin of the back. When the larva is maturing a hole forms in a swelling to be seen on the back and finally the larva emerges, drops to the ground, where it pupates and becomes adult. This fly, therefore, spoils a great many hides in some countries, because it leaves a blemish in the leather where the larva emerges. Considerable controversy takes place from time to time in New Zealand over the possibility of this fly coming into New Zealand in cattle from Canada. Actually there is only the most slender chance, for these reasons: The season of emergence differs from that in Canada and the larva usually dies from exposure. No adult flies have ever been known to appear in New Zealand from larvæ from imported cattle. Larvæ are watched for in quarantine here and for a considerable time after the animals leave quarantine, each larva being squeezed out and destroyed in those animals found affected.

Flies of certain varieties may inadvertently cause cancer in horses. There is one fly which drops a live round worm larva on to the third eyelid of the horse. This larva burrows, and, finding itself in the eye, instead of in the stomach of the horse, it dies. The resultant irritation of the tissues sets up a form of cancer which will finally eat away the side of the face and eye, and the horse has to be destroyed.

Of the other external parasites, the cattle-tick is perhaps the most important, and yet, in spite of the fear it has created in the minds of the farming community, the species present in New Zealand is comparatively harmless. We have no blood diseases to be transmitted, and consequently the only damage done is to hides. In any case, the New Zealand species of tick will not transmit disease when given the chance. Eggs of the tick are laid on the ground in hundreds, the young larvæ hatch out and climb up grass-stalks, &c., and so on to stock, even birds such as sea-gulls being so visited. The larvæ, after a feed, drop off and become nymphs. These again climb on to cattle, gorge themselves on blood, and drop off to become adults, when the animal host is again visited for feeding purposes. Lizards and birds, such as the kiwi, penguin, and sea-gull, carry various species of ticks other than the cattle-tick, but they, again, are quite harmless.

The mange parasite has recently come into some prominence in New Zealand in pigs. This minute form of animal life burrows into the skin and in the burrows lays eggs which there hatch and become adult parasites. Such skin parasites are easily overcome by oily dressings, and so, for control purposes, pigs are given a swim in crude oil to kill the parasite. We are fortunate that sheep scab, which is also due to a mange parasite, is not known in New Zealand. Further, dogs which may suffer are seen affected only extremely rarely in this country. Actually only three cases of true mange have come under my notice in ten years. This statement is made to counteract the many misstatements which one hears from time to time concerning mange in dogs of this country.

Most animals have their own species of flea, but a flea is only dangerous when it can transmit a blood disease from one affected

animal to a clean one. The worst of such diseases is bubonic plague, transmitted by a rat flea from the rat to man or from rat to rat. Rats are therefore barred from entering New Zealand from countries such as India, as they are distinctly undesirable immigrants.

Internal Parasites.

A representative of the internal parasites is the liver-fluke, a flat worm mainly found in sheep, but also in cattle in the Hawke's Bay region. This parasite has one of the most interesting of life-cycles. It not only parasitizes a warm-blooded animal, but during its growth parasitizes a small fresh-water snail, and then finally causes the death of the sheep. The adult parasite is a flat leaf-shaped worm found in the bile-ducts of the liver. It lays large numbers of eggs, which pass out in the bile and reach damp areas of pasture about creeks and swamps. Here the egg hatches, and a larva swims about in the water. It then attacks a small snail and bores its way through into the liver of that small host. Here several changes are undergone, until the parasites, which have now bred into hundreds in the snail from a single one, are ready to break free once more. When they enter the water they swim about and finally attach themselves to a plant, from which position a sheep picks them off when feeding in the pond or swamp. The larva which was at that time encysted comes into active life once more in the sheep-stomach, and when it reaches the intestine burrows through into the body cavity. Here it crawls about until it finds the liver, into which it burrows until a bile-duct is found and entered, where the the parasite grows until it becomes adult. The parasites when numerous so disarrange the liver function that the pitiable sheep dies with symptoms of dropsy and anæmia. That of course is bad enough, but it was found some eight years ago that these young larvæ entering the liver caused such damage that a certain germ which frequently lurks in the liver could take possession of the damaged area, setting up a spot of necrosis and from there issue quantities of such a strong poison that the affected sheep died within twelve to twenty-four hours. Many thousands of sheep died in that way at one time, until the reason for death was found, and control of the fluke attempted. Control, when you study it, is easy, for if you break the life-cycle of any parasite it must die out, and to break the life-cycle of the fluke it is only necessary to kill the snail. This was done by means of drainage and copper sulphate on many farms in Hawke's Bay, with the result that whereas annually large numbers of sheep at one time died mysteriously and suddenly this now does not occur. Some drugs, too, were found to act on the adult fluke in the liver, and therefore by drenching sheep and by treating swamps one gets 100 per cent. efficiency in killing off fluke.

Tape-worms are a source of considerable loss to the farming community in New Zealand, and also the general public when one realizes that in New Zealand some eighty operations are performed annually on human beings to free them from hydatid cysts which have been contracted from dogs. There are a number of varieties of tape-worms, but the true tape-worm is one of the parasites which have two hosts, the one in which they exist as adults, and that is usually a carnivorous animal, and the other where they exist in larval form, and that host is herbivorous or omnivorous and possibly able to be eaten by the carnivors.

The general life-history is this: An adult tape-worm in the intestine of the dog, for example, drops segments off the end of the whole tape-worm and these segments pass out in the fæces to the ground. Each segment is full of large numbers of eggs, which, when the segment dries and ruptures are liberated in the vicinity and may blow about in the dust or get carried about by animals, or very frequently by the dog itself, owing to the objectionable habit of dogs, or to the fact that some dogs are not given sufficient liberty to get away from their kennels to defæcate. Susceptible animals later take in such eggs with their food. The egg ruptures and liberates a larva which passes through the intestinal wall and may enter the blood-stream to pass to various organs of the body, or they may crawl to the liver and enter it or to the lungs to grow into the next stage, the bladder-like cystic stage. In the parasite affecting man the cyst stage grows quite large, numerous small heads being formed inside the cyst, each head capable when it gets back to the dog of forming another tape-worm. In addition, in man what are called daughter cysts may form, and if these get loose in the body of the host the outlook becomes serious. Usually hydatid cysts are picked up by children and the result of their growth is not felt until the child becomes adult.

Where the farmer sees the parasite is in the liver and lungs of his sheep. In cattle the cysts, when formed, are sterile and are not dangerous, but it is the sheep which perpetuates the disease and so makes the country dog a danger to children. So many cysts are present in the livers of sheep in New Zealand that it is difficult to get sufficient sound livers for export purposes. That offers a distinct menace to country districts, for the majority of country dogs are affected with the adult form of the parasite—the tape-worm. Town dogs, it must be stressed, are not affected by this parasite, because they do not get the opportunity to feed on sheep carcasses or offal, and their meat is previously inspected by trained Inspectors at abattoirs before being sold. The only efficient way to control this parasite is by prevention, and that should offer no difficulty if the farmer controlled his dogs' food. Livers and lungs, if given to dogs, should be boiled, and on no account should dogs be allowed to wander and eat dead sheep about the farm. It is possible also to clean the parasite out of dogs fairly well by dosing them with Areca nut or with Arecoline hydrobromide, which is a purer form of the Areca nut, and this dosage should, in the country, be repeated every three months.

There is a similar life-history in tape-worms between the cat and the mouse, the dog and the rabbit, the dog and his louse, and in some countries—not this—man and the cow. Poultry also suffer gravely from tape-worm, and they perpetuate the parasite by eating slugs, beetles, and earthworms which harbour the larval stages.

Round worms too can be dangerous, and their life-histories are full of interest. Trichinosis is a disease of pigs, rats, and man fortunately not known in New Zealand, where the larva of a little round worm establishes itself in the muscles of the person who eats the affected pork. The common large white worm known as the Ascaris is not content to propagate by a simple method, but the eggs passed out in the fæces and later returning to the stomach

through the mouth hatch out larvæ which burrow through the intestinal wall and wander round the body in the blood-stream, often until they get into the lung. Here they burrow into a bronchial tube and get coughed up, often at this stage causing a severe bronchitis. The material coughed up is then passed down to the stomach and the worm then becomes adult. Bronchitis in children and pigs is not infrequently caused by the passage of these large round worms' larvæ.

Sheep and calves and pigs suffer considerably from lung-worm, and on a still night considerable coughing can be heard round flocks of adult sheep and hoggets. Some of the worms causing this irritation pass as larvæ or eggs from the lung, are swallowed and pass out with the fæces, and then enter a water snail where they moult. They then again gain entrance to the sheep and pass by way of blood-vessels to the lungs after burrowing through the intestinal wall.

It is an extraordinary thing how seldom parasites lose their way in the animal body during their strange journeyings up and down the internal organs. Some sense guides them, nature apparently keeping on the winning-side when the host has not observed the laws of cleanliness.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 16th November to 14th December, 1933, include the following of agricultural interest:—

No. 70482: Device for holding nozzle of garden-hose; R. G. Bell. No. 70963: Holders for butchers' knives; A. S. Cross and S. E. Smith. No. 71043: Egg-grader; W. G. Taylor, O. Boucher, and M. V. Blake. No. 71093: Concrete butt; Hill Imperishable Post Butt Co., Ltd. No. 69185 and No. 69186: Treatment of meat; Smith Wilkinson Proprietary, Ltd. No. 69323: Fencing-staple; H. C. Rasmussen and G. Phillips. No. 70539: Sheep-dipping; C. Lilley. No. 70937: Refrigerating; Imperial Chemical Industries, Ltd. No. 71026; Wool-cleaning; W. Vicars. No. 71129: Coating for cured meats; J. C. Hutton Pty., Ltd. No. 71141: Gate fastener; W. A. Stephenson. No. 71159: Fertilizer; Cresco Fertilizers, Ltd. No. 71164: Fertilizer; J. A. Heskett.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

Oil Spray Experiments on Red Mite Eggs.—The Entomologist, Plant Research Station, reports that numerous tests on the ovicidal effect of sprays on red mite eggs were carried out during the winter last year. The experiments indicated that 90 per cent. of the winter eggs of the mites are susceptible to oil treatment when the oil is applied at a concentration of 1–10.

Cropping to Control Blackberry.—Experience in the North Island points to the need of two ploughings and two crops in one year to control blackberry. A common practice is to plough in late winter or early spring and sow a crop of turnips or rape, giving a heavy (say, 3 cwt. to 4 cwt. an acre) dressing of suitable fertilizer, so as to ensure a heavy crop, which is fed off in January or February. The land is reploughed at once and given a heavy seeding of a cereal crop—*e.g.*, Algerian oats, or Algerian oats and tares preferably, and again fertilizer is applied liberally. Usually only odd plants survive this cropping, and they can be pulled out by hand at a third ploughing.

AGRICULTURAL LEGISLATION OF 1933.

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LEGISLATION enacted during the New Zealand parliamentary session of 1933 and directly coming within the scope of the Department of Agriculture consisted of the Agricultural and Pastoral Societies Amendment Act, the Co-operative Pig-marketing Companies Act, the Dairy Industry Amendment Act, the Orchard-tax Amendment Act, and the Poultry-runs Registration Act. The following notes set out the position briefly with respect to each Act :—

AGRICULTURAL AND PASTORAL SOCIETIES AMENDMENT ACT, 1933.

The Act confers power on societies incorporated under the principal Act to make by-laws controlling the admission of persons to Agricultural and Pastoral Association shows. The by-laws may provide for the exclusion from agricultural and pastoral shows of specified classes of persons either absolutely or subject to such conditions as may be prescribed therein ; for the issue of licenses to specified classes of persons, and for the exclusion of persons of a specified class unless they are duly licensed.

No by-law or any amendment or revocation thereof shall be made until a draft is submitted to and approved by the Governor-General, and no such by-law shall come into force until it is gazetted by the Minister of Agriculture.

Licenses which may be issued either by the society making the by-laws, or by any authorized society or person or body of persons, shall enure for a period not exceeding two years or such lesser period as is prescribed in the by-laws. No license shall be issued to any person under the age of sixteen years.

Any person of a class in respect of which a license is required who has been refused a license or whose license has been revoked is given the right of appeal to a Magistrate or to two Justices whose determination on such appeal shall be final and conclusive.

CO-OPERATIVE PIG-MARKETING COMPANIES ACT, 1933.

This statute confers on co-operative pig-marketing companies on becoming registered thereunder the same rights in relation to the surrender and reissue of shares as are possessed by co-operative dairy companies under Part III of the Dairy Industry Act, 1908. The general rule is that a company may not accept surrenders of its own shares. For the purposes of the Act a co-operative pig-marketing company is defined as a company which is incorporated under the Companies Act (whether before or after the passing of the Act) the principal object of which is the treatment for human consumption of pigs supplied to the company by its shareholders and the marketing of the produce, and of the shares issued by which not less than 60 per cent. in nominal value are held by persons engaged in supplying pigs to the company.

The provisions of the Act follow, with the necessary modifications only, the corresponding provisions of the Dairy Industry

Act, 1908, relating to co-operative dairy companies including section 8 of the Dairy Industry Amendment Act, 1926.

The administration of the Act is a matter for the Registrar of Companies.

Dairy Industry Amendment Act, 1933.

In general terms the Act confers additional powers to regulate the dairy industry by way of regulations under the Act requiring the registration of persons competent to be employed as dairy-factory managers with power to set up a Registration Board for the purpose, and regulating the supply of milk or cream to dairy factories by restricting suppliers from transferring their supply from one dairy factory to another during the same manufacturing season.

With regard to the registration of dairy-factory managers, it is anticipated that regulations on the subject will be made and brought into operation for the commencement of the next manufacturing season.

In May last a regulation was made restricting the transfer of supply of milk or cream, but was subsequently challenged and declared by the Court of Appeal to be *ultra vires* the Dairy Industry Act, 1908. The amending Act under notice removes all doubts as to the power of the Governor-General in Council to make a similar regulation in the interests of the dairy industry generally, and the necessary action to this end is now being taken.

By section 5 of the Act any person who is aggrieved by the operation of regulations governing the registration of dairy-factory managers is given the right of appeal to a Magistrate and two assessors, one to be appointed by the appellant and one by the Minister of Agriculture or his nominee. Any person similarly aggrieved in respect of the operation of regulations restricting the transfer of supply of milk or cream from one dairy factory to another is given the right of appeal to a Magistrate exercising jurisdiction in the locality in which the appellant's dairy is situated. In either case the determination on appeal shall be final.

By section 3 of the Act any dairy company is empowered to make an annual charge to cover the cost of accounting in respect of assignments or orders made by a supplier on moneys payable to him for milk, cream, &c., supplied to the company. Such charge shall not exceed £1 or 2½ per cent. of the amount of all such assignments or orders, whichever sum is the less. The annual charge may be deducted from the amount payable under the assignment or order, and the sum so deducted may be recovered from the supplier by the person entitled under the assignment or order. The authorized charge may be made in respect of moneys paid after the passing of the Act in terms of an assignment or order given or made before the passing of the Act.

Orchard-tax Amendment Act, 1933.

Under the Orchard-tax Act, 1927, an orchard-tax at the rate of 1s. per acre is imposed for the general purposes of the fruit-growing industry; in addition, a special tax not exceeding 5s. per acre may be imposed in commercial fruitgrowing districts to

provide funds for protection against fireblight. As fireblight does not attack citrus or stone fruits, the amending Act exempts from special orchard-tax (fireblight tax) those orchards in which such fruits are exclusively grown, or, in the case of mixed orchards, those areas that are used exclusively for the production of citrus or stone fruits.

By section 3 of the statute provision is made for payment out of the proceeds of the fireblight tax to members of Fireblight Committees of fees in respect of their services.

Poultry-runs Registration Act, 1933.

This statute makes provision for the registration of premises used for the keeping of certain poultry and the production of eggs for sale. Provision is made for the payment of fees for registration for the purpose of providing funds for the organization and development of the poultry industry.

The Act does not apply to poultry other than hens and ducks, nor to hens and ducks less than six months old, nor to persons keeping less than twenty-five such birds or keeping poultry for their own use, and not producing eggs for sale. Save as above, every poultry-keeper producing eggs for sale is required to register his premises in the month of June in each year or within one month after the establishment of the poultry-run. Registration will be effected in accordance with regulations to be promoted for the purpose and brought into force prior to 1st June next. For the purposes of the Act a poultry-run is deemed to be established when it is established for the purpose of producing eggs for sale or when any eggs produced in it are sold or offered for sale. The fee for registration is 2s. 6d. per hundred head of poultry kept on the premises at the time of application for registration. No fee is payable, however, where a person is exempted by the Minister of Agriculture from liability to pay the same by reason of undue hardship or other sufficient cause.

The Act provides for the setting-up of a Board called the New Zealand Poultry Board, comprising two Government representatives and four producers' representatives. In addition to being charged with the administration of the Act and of the regulations governing registration, the Board is empowered to organize and develop the poultry industry, and may exercise such powers, not inconsistent with the statute, as are reasonably necessary for the effective performance of its duties and functions. Amongst other things, the funds of the Board may be applied in reimbursement of reasonable expenses, not exceeding £500, incurred by the New Zealand Poultry Association in organizing the poultry industry before the commencement of the Act and in payment of subsidies, if approved by the Minister of Agriculture, to producers in respect of the export of eggs.

The statute contains provision for the taking of a poll of the payers of fees on a proposal that the Act be allowed to expire in 1937. No poll shall be taken, however, except on a petition presented to the Minister of Agriculture during the month of February, 1937, and signed by not less than 20 per cent. of the payers of fees. If a poll is necessary it must be taken not later than 30th April, 1937, and may be taken by post. If a poll is taken and the proposal that the Act

be allowed to expire is carried, the statute shall continue in force until 31st May, 1937, and shall then be deemed to be repealed, whereupon, before or after that date, the Governor-General in Council is empowered to dissolve the Board and to make such provision with respect to the distribution of the Board's assets as is deemed equitable.

General.

For the purposes of providing a method by which sodium chlorate might be made available to farmers for the eradication of noxious weeds, particularly ragwort, at as cheap a rate as possible section 48 of the Finance Act, 1933 (No. 2), empowers County Councils to purchase sodium chlorate in bulk at the best price obtainable and to sell the same or distribute it free in such quantities and on such terms as they think fit. Special loans are authorized to be raised for the purpose without taking the steps prescribed by the Local Bodies' Loans Act, 1926, and the moneys received from the sale of this material may be applied either in the purchase of additional supplies or in repayment of the loan.

The Auckland Metropolitan Milk Act, 1933, provides for the setting-up of a council called the Auckland Metropolitan Milk Council, consisting of nine members, of whom three members shall represent the Auckland City Council, while the other local authorities within the Auckland Metropolitan Milk District, as defined in section 3, the milk-vendors, and the dairymen producing milk for sale within the district shall each be represented by two members. The Council is clothed with all necessary powers to regulate and control the collection, treatment, carriage, deposit, storage, distribution, and sale of milk for human consumption within the metropolitan district, including price-fixation from the source of supply to the consumer.

WHAT IS LIMONITE?

EXPLANATION AND WARNING.

B. C. Aston, Chief Chemist, Department of Agriculture, Wellington.

Limonite is one of the brown hydrated oxides of iron produced by the natural processes of weathering from the parent rocks and containing 14·4 per cent. of water of combination, a variable quantity of moisture, impurity (earthy matter), and about 60 to 80 per cent. ferric oxide. Limonite occurs in nature as massive (rock-like) deposits or occasionally as an earthy (soft) form, and also mixed with clay as "yellow clay ironstone." Limonite also exists in most soils which owe their colour to oxides of iron; limonite giving a brown colour, göthite a yellowish colour, and hæmatite a red colour. It will be convenient here to tabulate descriptions of these compounds for the purpose of seeing at a glance the character and composition of the pure material.

In addition to these three forms of ferric oxide, there are to be found in many North Island soils black grains which are magnetic ironsand (chiefly Fe_3O_4) and, from their persistence in soils, they are evidently insoluble in soil water. The substances mentioned above are the commonest forms of iron met with in nature, although there are many others to which it is not here necessary to refer.

Three Minerals containing Ferric Oxide.

Name of Mineral.	Chemical Formula.	Character.	Combined Water.	Ferric Oxide.
			Per Cent.	Per Cent.
Limonite..	$2Fe_2O_3,3H_2O$	Non-crystalline, powder, brown	14·4	85·5
Göthite ..	Fe_2O_3,H_2O	Crystalline, powder, brownish-yellow	10·1	89·9
Hæmatite	Fe_2O_3 ..	Sometimes crystalline, powder, red	Nil	100·0

Many experiments with sheep and cattle have shown that Whangarei limonite when air-dried, finely ground, and mixed with medium-grade salt, is readily eaten by stock in the typically bush-sick districts of the North Island, and thus effectually and economically prevents bush sickness where the mortality, without mineral treatment or changing of stock to other areas, is 100 per cent. It also increases the production in localities where mature cows are only slightly affected, and enables young stock to be raised where there is usually heavy mortality. Limonite may be given to calves supplied in the feed milk, about a teaspoonful to a bucket, with excellent results, and suspended in water is effective for curing bush sickness in sheep and lambs.

There are strong reasons for thinking that in some districts remote from the typical bush-sick areas where young animals suffer from a malnutrition the symptoms of which are emaciation and anæmia, on land of high quality, that limonite will enable the young stock to grow and develop normally. There is therefore no doubt that limonite is destined to play a considerable part in the compounding of licks for animal consumption generally, as well as for use on the special pumice areas where the administration of iron licks to stock is an essential and now well-recognized addition to farm routine.

It has been a common practice to introduce about 5 per cent. of an iron salt into proprietary licks for stock, and for this purpose sulphate of iron (ferrous sulphate) has been the salt used. This is not nearly so efficient as limonite in combating bush sickness, and sheep evidently do not like the taste of soluble iron compounds. Several lick-makers are therefore using the limonite from Kamo (Whangarei) deposit or from one farther north (Okaihau) to replace ferrous sulphate. It is necessary to emphasize the instructions given on page 3 of "Control of Bush Sickness in Sheep" pamphlet, which described the method of feeding limonite and the results obtained. (See this *Journal*, June, 1932, page 369, "They were warned against employing artificial heat and were asked to employ air-dried material in order to ensure that it was in as natural a state as possible so far as the solubility was concerned.") Manufacturers should take note that it is undesirable to heat limonite artificially. The greatest success from limonite has been from a factory where only air-drying is practised and where the spalls of ironstone quarried from the deposit near the surface are piled up into great heaps as shown on page 370 of this *Journal* for June, 1932, allowed to air-dry as much as possible, and then broken, crushed, and pulverized in reducing-machinery and put through a fine sieve, after which the powder is ready for use as a lick, only requiring to be mixed with an equal weight of salt. As might have been expected, the sieving of such a moist substance is

not easy, and clogging takes place to a considerable extent. The natural impulse to make the powder more granular by heating in order that the sieving may be speeded up must, however, be resisted, as there is no doubt that a baked limonite will be far less effective than one that is merely air-dried. The heating of limonite much above the ordinary temperature of the air is sufficient to change its colour from brown to a reddish-brown. Limonite is probably a very unstable mineral, and this, combined with insolubility in water, indicating tastelessness, affords an explanation why it is so successful in supplying available iron to ruminant stock. Limonite has the same percentage composition as the artificial yellow ferric hydrate ($2Fe_2O_3,3H_2O$) made by adding ammonia to ferric chloride dissolved in water. By boiling this precipitate in water for seven or eight hours the colour changes from ochre yellow to brick red, and the hydrate thus altered is scarcely acted on by strong nitric acid and but very slowly by hydrochloric acid.

In preparing the natural hydrated limonite for consumption as a stock-lick, caution should therefore be exercised in three directions if the compound is to have efficacy as a cure for iron deficiency or bush sickness in stock.

(1) The material must on no account be artificially heated in order to facilitate sieving, and should be dried by wind and sun only. A warning against overheating was given to the first manufacturers of ground limonite for stock in June, 1932 (see *Journal*, June, 1932, page 369), and this firm has never departed from the original method and has never had a failure—a very satisfactory record.

(2) The material must be ground as finely as possible, as sheep refuse to eat a material which is too gritty.

(3) No lime or other alkaline material should be mixed with the lick. Salt of medium-grade fineness is the best inducement for stock to eat limonite, but in districts near the sea, or places where stock refuse to be attracted by salt, the ground limonite must be mixed with something that is attractive, such as molasses.

There are, fortunately, in the far North of New Zealand inexhaustible supplies of limonite lying near the surface. There is therefore no reason why this abundant and cheap material should not be fully utilized throughout the Dominion. The efficacy of any iron oxide other than limonite from Whangarei, or one of the same nature and composition, should be carefully tested by field experiments before being placed on the market.

RETIREMENT OF MR. R. H. HOOPER AS EDITOR.

Recently Mr. R. H. Hooper, who had held the position of Editor to the Department of Agriculture, which included editorship of the *Journal of Agriculture*, for over eighteen years, retired on superannuation at the statutory age of sixty-five. He was farewelled by officers of the Department and Dr. C. J. Reakes, Director-General of Agriculture, who made happy references to Mr. Hooper's personal qualities, presented him, on behalf of the Department's staff throughout the Dominion, with a high-grade English clock suitably inscribed and with a handsome fruit-bowl for Mrs. Hooper. Mr. Hooper joined the Department in 1900. After two years he was allotted overseas work mainly of a publicity nature for the State. Subsequently he was reappointed to the Department and occupied various positions, including that of District Agent at Wanganui, before being appointed to the editorship of the Department in 1915.

SEASONAL NOTES.

THE FARM.

Utilization of Forage Crops.

Crops providing feed in late summer and early autumn are sometimes not used to the best advantage. In illustration of this is the fact that, in dairying, crops such as millet, maize, or turnips, used when they are most urgently needed, may eventually give greater cash returns than if they were used when fully grown. The heavy fall in butterfat production that often occurs in February is serious not only because of its direct effect on the returns for that month, but also because, unfortunately, a herd which falls off in its production at an unduly rapid rate at that period is unlikely during the several remaining months of the producing season to return to the standard of production it would have maintained had there not occurred an unsatisfactory supply of feed in February. From this it follows that in late summer it is sound practice to use special crops grown to supplement the pastures, not necessarily at the peak of their yield, but at the peak of their economic effectiveness.

Another aspect of the same matter is the fact that green crops such as millet, red clover, and lucerne are at times allowed to become too mature and woody before being fed to stock. Usually at this season the qualities primarily needed in crops used for green feed are high digestibility, high mineral content, and high content of the particular substances called proteins, which are required for milk and meat production. In all these vital qualities there is a decline in green feed as it approaches maturity. Hence the mere provision of green feed does not ensure proper feeding at this season. The nature of the green feed is of prime importance—such feed should be practically free from fibre or woodiness—*e.g.*, soft turnips or young succulent leaf growth. These considerations make clear the reasons why at times good milk yield does not result from freely feeding such crops as lucerne and millet, which, while quite green, have developed the woodiness that is associated with poor feeding-value for stock that are producing heavily or growing rapidly. Incidental to the matter directly under consideration, but of great practical moment, is the fact that the woodiness which proves undesirable in clover, millet, or lucerne also proves similarly undesirable in pastures in which woodiness is associated with flower-stalk development.

As grass silage normally is made from growth in which there has been a considerable development of maturity and woodiness, it follows from the preceding statements that grass silage at times is not a completely satisfactory feed with which to supplement pastures in summer and autumn, and that the extent to which it proves unsuitable for this purpose depends upon (1) the degree of maturity reached in the material used in the production of the silage, and (2) the productive capacity of the stock.

Silage made from growth mown when at a stage less mature and more leafy than that normally adopted in mowing for hay would be less woody and more digestible than silage made from growth mown at or after reaching the stage when cutting for hay is ordinarily carried out. Again, silage of a particular degree of maturity might be quite suitable for the summer supplementary feeding of cows producing not more than 1 lb. of butterfat daily, but unsatisfactory for the feeding of cows producing in the vicinity of 2 lb. of butterfat daily. Further, the type of pasture growth fed in conjunction with silage would influence the suitability of the silage as a

supplementary feed—silage supplementing distinctly leafy pasture might be quite satisfactory whereas the same kind of silage supplementing stemmy pastures might give definitely poor results. Probably also the nature of the curing which silage has undergone influences its suitability as a summer supplementary feed. From farm experience in New Zealand it has been concluded that silage cured so that it is greenish to dirty yellow in colour is more suitable in its protein content—which is of much moment—for highly producing stock than silage subjected to curing which gives it a brownish to black colour, and the findings from New Zealand farm experience are supported by the results of recent systematic research in Europe.

To sum up, the suitability of silage as a feed to supplement pastures in late summer and autumn is influenced by—(1) the maturity of the material used in the making of the silage; (2) the production of the stock to which it is fed; (3) the nature of the pasture supplemented by the silage; (4) the type of curing the silage undergoes.

Hence the value of silage for the purpose of supplementing pastures in summer is determined to a large extent by circumstances, and so we find some, basing their remarks on experience, roundly condemning the summer use of silage as a pasture supplement and others, also speaking from experience, just as emphatically commending it. From the position as outlined above, it should be clear that the contradictory views may be correct interpretations of the different sets of experiences upon which they are based. But generally the silage produced under current practice is not so fitted to lead to a reasonably high production of butterfat as non-woody feeds such as soft turnips, kales, and leafy clover or grass. Actual instances have been recorded in which changes in summer supplementary feed from silage to soft turnips and to chou moellier have been followed by an increased production of butterfat. However, it is of importance to bear in mind that although silage may not generally be the ideal material for supplementing dairy pastures in summer it undoubtedly is of value for this purpose—a fact the truth of which thousands of farmers can testify.

Pasture Establishment.

Apart from districts in which relatively early heavy frosts occur, autumn sowing of seed for permanent pastures is, on the results of field experience, much favoured. March sowings are considered generally to give the best results, chiefly because in March the soil frequently possesses the conditions of moisture and warmth which allows of rapid and vigorous establishment. The sowings which at times are made in late autumn or early winter are prone to be associated with poor establishment, especially of the clovers; a sowing which is too late by only a few days may give a markedly poorer sward than a similar one made far enough ahead of the advent of conditions unfavourable to pasture seedlings.

In general, the sowing of companion crops such as oats with pasture seeds is not justified. At times such crops have been employed partly on the grounds that they provide shelter to the pasture seedlings. Actually they readily provide too much shelter and reduce to an undesirable extent, not only the supply of soil moisture, but also that of direct light, and, of course, the better the companion crop the more intense will be this undesirable effect. Hence, while the value of such companion crops as a means of obtaining additional early feed is undoubted, that value may be more than offset by the harmful effect of the crop on the pasture—an effect which ordinarily would be felt over a number of years. Exceptional cases may justify the use of companion crops, and in these cases white oats or barley may suitably be used. In the interest of the pasture, the amount of cereal-seed used should be less than if a cereal crop alone were being sown.

Some points of general moment in pasture establishment are—

(1) Since the introduction of certification of seed, each year has given additional conclusive evidence that the use of certified seed is economically well worth while.

(2) The necessity for a fine firm seed-bed is great, and neglect relative to this is fruitful of unsatisfactory results.

(3) Top-dressing at the time of sowing of seed frequently contributes materially to vigorous successful establishment. As a rule, it is well to top-dress early—in time to prevent the onset of deterioration, instead of being faced with the need of top-dressing later in an endeavour to repair a sward which has deteriorated.

(4) The advisability of rolling at seed-sowing time is governed by circumstances. One rule of some value is to roll under dry fine conditions and not to roll under wet conditions with frequent rain.

Pasture Seed Mixtures.

Detailed information about seed mixtures for specific purposes and conditions is available from local officers of the Fields Division. For general guidance the following mixtures are recommended by Mr. E. Bruce Levy, Agrostologist, Department of Agriculture :—

A. For wide use in both North and South Islands on country with a carrying-capacity which is or can economically be made at the rate of one cow to 2 or 3 acres or better, or at the rate of 2 to 3 ewes to the acre or better: True perennial rye-grass, 20 lb. to 25 lb.; New Zealand cocksfoot, 10 lb. to 15 lb.; crested dogstail, 3 lb.; Timothy, 3 lb.; New Zealand white clover, 2 lb.; red clover, 3 lb.: total, 46 lb.

Amounts given in this and other mixtures are per acre. The smaller amount of rye-grass is to be used mainly when the summer rainfall is below that needed for good results with rye-grass, and under these conditions the larger amount of cocksfoot is advisable, as it also is when it would not be economically attractive to raise the fertility of the land by top-dressing up to standard of fertility required by successful rye-grass.

B. For temporary pastures of one to two years' duration: Italian rye-grass, 25 lb. to 30 lb.; red clover, 6 lb.: total, 31 lb. to 36 lb.

For a temporary pasture to serve as an autumn-sown catch-crop to be followed by another spring-sown crop, genuine Western Wolths, on account of heavy early growth, could usefully replace Italian rye-grass, which, however, should be employed in all temporary pastures other than autumn-sown catch-crops.

C. For short-rotation pastures which are intended to have a life of two to three years: Italian rye-grass, 15 lb.; perennial rye-grass, 15 lb.; red clover, 4 lb.; white clover, 2 lb.: total, 36 lb.

Short-rotation pastures are useful mainly on farms on which, largely because of climatic conditions, arable crops instead of pastures are the dominant concern.

D. For sowing the primary burn out of the bush: Cocksfoot, 8 lb.; crested dogstail, 3 lb.; Italian rye-grass, 4 lb.; true perennial rye-grass, 12 lb.; Poa pratensis, 1 lb.; brown-top, 1½ lb.; white clover, 2 lb.; Lotus major, 1 lb.; Danthonia pilosa, 3 lb.: total, 35½ lb.

E. For the sowing of secondary-bush burns—typical bracken, hard fern, and manuka burns: Perennial rye-grass, 8 lb.; brown-top, 2 lb.; dogstail, 4 lb.; white clover, 1 lb.; Lotus major, 1 lb.; Danthonia pilosa, 3 lb.: total, 19 lb.

Minor modifications of most of the above mixtures may at times be advisable. Advice relative to these modifications is available from district officers of the Fields Division.

Pasture Management.

Topping of pastures as described in last month's notes may be advisable in March. As grass harrowing during dry summer conditions is seldom advisable it is often good practice, as soon as March rains occur, to push ahead with harrowing in order to minimize delay in distributing droppings which have accumulated during the summer.

In the main grass-farming districts, top-dressing with phosphates during the February–April period is widely advisable. One of the important advantages of such top-dressing is that it usually brings about prior to the dormant winter period an appreciable increase in growth which is valuable because it assists not only in increasing the winter supply of feed, but also in enabling stock to enter the winter with additional vigour and condition which stands to them in later critical periods.

A second material advantage of fall top-dressing is that, while it stimulates growth in the early spring practically to the same extent as would spring top-dressing, it is declining in its effect by the time summer is reached, and so does not cause such a rush of growth as does spring top-dressing—a rush which tends to intensify the practical difficulties in effecting satisfactory control of pasture growth in early summer.

Emergency Catch-cropping.

Land from which such crops as oats, wheat, maize, millet, soft turnips, or rape have just been removed may often advantageously be ploughed and sown without delay in temporary pasture, oats, or barley in the manner described in last month's notes. If such land is so hard as to make satisfactory skim ploughing impracticable, then cultivation with disks set with plenty of cut will often serve suitably as an alternative to the skim ploughing. The crops mentioned above, and especially the temporary pasture, should as a rule be sown with as little delay as possible.

It is not necessary to reduce to a fine condition the surface layer of the seed-bed of autumn-sown crops. In fact, the occurrence of clods is at times definitely advantageous—they prevent the caking of the surfaces which heavy beating rains may produce on soils the surface layers of which have been worked down to a fine condition.

—R. P. Connell, Fields Division, Palmerston North.

Measures against Internal Parasites.

From now onwards in the dairying districts farmers will guard against the presence of internal parasites in their young calves. The worms causing a characteristic cough in young calves are located in the small tubes of the lungs. The other worms which cause scour, loss of condition, and even emaciation are located in the fourth stomach and small intestines. These parasites frequently infest young growing calves during the autumn months, being more severe on farms which are low-lying, on farms subject to flooding, on farms where overstocking is carried out, and on all farms in a wet or showery autumn.

The worms in the small tubes in the lungs cause " husk " or " hoose " in calves, often spoken of as lung-worm disease. The other parasites in the stomach and intestines cause inflammation of these organs, resulting in scouring and loss of condition. It is partly on account of parasites such as these that certain paddocks on a farm become what is known as " calf-sick." It is therefore advisable to guard against any of the above predisposing factors which encourage the spread and growth of parasites in young stock. It is scarcely necessary to state that parasites have a decidedly retarding influence on the growth and development of all young stock, apart altogether from the mortality which they cause from year to year.

As these notes will appear in plenty of time to allow owners to take steps to prevent the damage done by parasites from becoming serious, it is necessary to state here only that no better means of prevention can be adopted than by increasing the food ration from now onwards. A change of pasture is advisable, a paddock which has not been grazed by young stock being the most suitable. A crop of aftermath following a cutting for hay or ensilage often provides suitable grazing for the purpose. If such a crop is not available affected calves should be given a supplementary ration of crushed oats and moose nuts. In addition it is advisable to provide a salt lick, especially a lick containing iron in some form. As infested stock are invariably anæmic, the iron content of the lick is necessary to assist in the maintenance of the red-cell content of the blood. A suitable lick may be composed of nine to nine and a half parts of salt with from a half to one part of limonite added. Under such conditions of feeding and good husbandry it may not be necessary to resort to drenches and medicine for the eradication of worms. This result is to be desired, as prevention is always better than cure. Moreover, in badly infested calves, even though drenching is resorted to, it is still necessary to increase the food-supply to overcome an attack.

—J. E. McIlwaine, Veterinarian, Live Stock Division, Wellington.

THE ORCHARD.

Seasonal Spraying.

GROWERS are again urged not to cease spraying operations until all danger from insect and fungi attack is over. Should the autumn prove to be hot and dry, red-mite, apple-leaf hopper, codling moth, and leaf-roller caterpillar will still be active and capable of causing much damage to the fruit and tree if left uncontrolled. On the other hand, a wet or even a damp autumn will be favourable for fungous diseases, particularly black-spot infection. It is possible that the average grower does not realize the paramount importance of keeping red-mite and apple-leaf hopper under at least reasonable control. From a control point of view, these insects may be grouped together: their habits and methods of feeding are similar in so far as both are sucking insects finding a common feeding-ground chiefly on the underside of the foliage. Unlike the injury caused by codling-moth and leaf-roller caterpillar, that caused by these pests may not result in visible injury on the fruit. Their attack on the foliage, however, is often so severe as not only to weaken the tree, but to reduce the crop by causing the fruit to fall. In addition, it may prevent fruit buds for future crops from developing. Thus, indirectly, the invisible injury to fruit caused by red-mite and apple-leaf hopper may easily result as disastrously as that caused by uncontrolled codling moth and leaf-roller caterpillar. It is advisable to continue with the combination spray as directed in last month's notes for control of black-spot, powdery mildew, codling moth, and leaf-roller caterpillar. For red-mite and apple-leaf hopper apply summer oil 1 per cent. to 2 per cent.; at least two applications at ten-day intervals will be necessary to achieve a satisfactory control. Care must be taken, however, not to apply summer oil until fourteen days have elapsed preceding or following sulphur in any form. From about the latter end of February and during the month of March red-mite winter egg-laying will commence, unless, of course, all live mites have been destroyed during the preceding month. Satisfactory control of red-mite may be achieved provided the operator is thorough in his work when applying the spray and does not delay the operation until after egg-laying has actually commenced.

Spraying stone fruits as recommended in December notes should be carried out.

Fruit Export.

Practically all packing-sheds will, ere this, be in commission as centres for the purpose of grading and packing fruit for export and for local markets. This subject was dealt with in last month's notes, therefore there is little that can be added to these notes except once more to stress the necessity for careful handling of all fruit, whether for export or for local market, the importance of maintaining the colour standard set for the variety, and the necessity for maintaining a uniform size throughout each case. Packers should be instructed to build the bulge in the case during the process of packing, and not simply fill the case with the required number of apples and leave the bulge to the lidding-press and to chance. The process of building in the bulge is quite simple and may be accomplished by placing one hand on top of the other and pressing into their respective pockets the apples at either end of the case (say, after the third layer has been placed in position), thus causing the pack to slightly pyramid or bulge in the centre. This operation takes very little time and saves considerable loss by eliminating the risk of bruising and cutting the fruit at either end of the case while on the lidding-press. The regulation bulge is 1½ in. top and bottom, not 3 in. on top or bottom only, which is often the case when the bulge is left entirely to the lidding-press.

The Packing-shed.

The packing-shed should be well ventilated, well lighted, and so arranged as to minimize double handling of cases of fruit. Fruit arriving from the orchard should be stacked in close proximity to the grader, from which point it should be moved on gradually from operator to operator until the completely finished case of fruit reaches the loading-out point where it should be carefully stacked ready for dispatch. Empty cases for packing, after being lined with corrugated strawboard or wood-wool, should be neatly stacked handy to the packers. The shed should be swept out at least once a day, and all rubbish such as loose paper and broken wire, &c., collected and destroyed or disposed of in some satisfactory manner. Waste fruit, if left lying in or about the packing-shed attracts flies and, apart from this, it is unsightly and quickly causes a very unpleasant smell. Uncleanliness may be eliminated if all such fruit is collected and placed in receptacles provided for the purpose. When full, or at the close of each day, the receptacles should be emptied and the contents burned or deeply buried.

The grading-machine will need constant attention to be kept clean and in good running-order. The bins should be constantly emptied of all deposits such as broken fruit, spurs, leaves, and dust, &c. On no account should they be overfilled, as overfilling is often responsible for bruising and stalk puncture, &c.

—J. W. Whelan, Orchard Instructor, Palmerston North.

Citrus Culture.

Owing to the dry weather experienced this summer, trees are backward in development, and little could be done to assist them, except where irrigation was possible. In order to minimize as much as possible the ill effects of the dry weather it will be well to carry out all possible cultural practices during the coming autumn. After the first rainfall the soil should be cultivated to break the surface, otherwise some of the benefit of the succeeding rains will be lost, as much water will run away. The trees may be expected to make more vigorous autumn growth than usual, and this should be attended to by pinching and spacing in order to ensure that the growth may be reasonably hard to withstand the frosts to be expected later. It is in winters following such seasons as the present one that winter-kill of tips is most common, mainly because the growth is soft.

Unfruitful trees or trees of poor type may be top-worked or budded over to more profitable kinds as soon as suitable bud-wood can be obtained. Shield budding into reasonably fresh bark on the main stems is generally satisfactory, and the limb in which the buds are inserted may be shortened somewhat to check the flow of sap. In selecting buds it is important that wood should be taken from trees of good habit that produce a desirable type of fruit. Strongly growing fleshy shoots and trees prone to developing excessive wood should be avoided, as these characteristics will be perpetuated in the new tree to the detriment of fruit-production. Short twigs on which fruit has been produced will provide the best bud-wood, which for satisfactory working should be round, free from thorns and carrying good plump buds. Triangular or flanged wood is not suitable, inasmuch as a sufficient width of bark cannot be obtained, and it is almost impossible to remove the surplus wood without damaging the eye. In budding seedling stocks it is important that the bud be inserted at least 9 in. above the ground-level to ensure that there will ultimately be a sufficient length of stock to protect the more susceptible varieties against infection by soil-inhabiting fungi such as collar-rot and brown rot.

—L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

Culling.

CULLING should be uppermost in the minds of every poultry-keeper at the present time. This is the period when the hens are finally laying before taking a rest prior to undergoing the moulting process, so there is no better time to choose the breeding specimens and to discard the drones. It is at this time, or just before the moulting process commences, that certain signs manifest themselves indicating whether a bird has in the past year been a heavy producer or whether she is likely to be one during the coming season. In a general way, these signs disappear as soon as the birds have moulted so that if this important work is delayed now, it is impossible for it to be carried out to the best advantage at a later date, chiefly for the reason that if left until the flock has fully moulted the matter of choosing between the good and bad layer becomes a difficult one. While the culling of undesirable stock and the selection of the best specimens for the breeding-pens are the chief essentials in successful poultry-keeping, these operations are probably the most difficult to teach the novice to carry out properly, other than by a practical demonstration. To those, however, who have not studied laying form throughout the season, some general points may be stated that will serve as a guide to assist in culling out the poor layers.

Other things being equal as to the time of hatching, and provided the flock has received uniform treatment as regards feeding and general management, usually it will be found a safe course to discard birds that moult first, and to retain the late moulters either for breeding or laying purposes. This point cannot be emphasized too strongly. What chance has the early moulter in an egg-laying competition? If first moulters are handled invariably they will be found to be overloaded with fat. They have been converting their food into flesh and fat—that is, if they are not light through having a weak constitution.

The late moulter usually will be found to have no superfluous flesh or fat upon her.

As to culling out the early moulters it is sometimes claimed that the bird which moults first must necessarily be producing when the feathers of the late moulters are being renewed and thereby showing as good a profit for the year as the late moulters. This may be true in some cases,

but generally it is not. It is reasonable that if a bird be a long season layer she must be a late moulter, for it is rarely indeed that fowls moult and continue laying at the same time. It will usually be found that the high-type layer—viz., the late moulter—will lay for several weeks longer in the autumn when the price of eggs is on the up grade than the early moulter, and then, after renewing its feathers, will resume laying before the birds that moult first. Of course, no rule is capable of universal application, and, not unlike all other things connected with poultry, local conditions must always be taken into account. The point cannot be emphasized too strongly that, as a general rule, the birds in their pullet year will commence to moult before the birds a year or more older. Especially does this apply if the latter were late moulters the previous year, so that when first and second season layers are running together, and there is no mark for age determination, the time of moulting will not give a good guide in the work of culling. In order to simplify the work of culling, all young birds should, for age determination, be marked in the web of the foot by a special punch made for the purpose. It is generally admitted that few hens show a satisfactory margin of profit after two laying seasons, and therefore such hens should be heavily culled immediately they show signs of terminating their second season of production. Those who have indifferent flocks would be well advised to make heavy culling, even in the case of those birds finishing their first laying season and, in particular, it is a safe course to discard all birds showing weak constitutions. The rule of keeping all birds until they have passed two laying seasons will not hold in these days of dear foods and low prices for eggs.

The general appearance, apart from the question of the time of moulting, gives a good guide to a bird's productive power at this period of the year. The heavy layer will present a more or less shabby appearance, and owing to this fact is often the first to be culled out by the inexperienced poultry-keeper. Birds which have a well kept glossy plumage and which are usually well above the ordinary weight of the breed, are flesh-makers, and therefore should be culled out. The good layer is always tightly and thickly feathered. Not only does loose feathering denote poor laying-capacity, but impaired constitution as well. The late moulter or the good layer at this season of the year will have well bleached shanks (in the yellow-legged birds); she will also be a heavy feeder, and still retain an active business-like appearance. The poor layer, apart from being an early moulter, is usually very fat, has a well-kept plumage, and bright-yellow legs.

The condition surrounding the abdomen also gives a good guide to laying capacity. In the good bird it will be found full, pliable, and soft to the touch. In the bird about to take her natural rest prior to moulting, it will be observed that the abdomen shrinks and is thick and hard to the touch. Owing to this shrinkage of the abdomen the bird will appear to have much longer legs than when she is in full laying condition.

The head of the bird is also a good guide in the classification of stock. The good layer will have bright prominent eyes, a clean face, free from wrinkles and feathers. Indeed, with the exceptionally heavy layer, it is not uncommon for the head to become completely devoid of feathers towards the termination of her laying season. Of course the feathers are always renewed later. Birds with coarse heads, feathered face, dull or sunken eyes, and wrinkled skin surrounding the eye are usually of poor laying-capacity and low vitality.

While the width of the pelvic bones is not an indication of laying powers, it is, however, a good guide as to whether a bird will lay in the near future, or whether she is taking the natural rest before moulting. If the bones are close together and the breast bone close up to them, it

is a sure sign that the bird will not lay for some time, and therefore will be unprofitable to keep. On the other hand, if the pelvic bones are set well apart, so that they will admit, say three fingers, and there is a good distance between the pelvic bones and the breast bone, and the abdomen is full and soft to the touch it may be taken for granted that the bird is laying or will soon commence to lay and is well worth retaining in the flock for another year or at any rate until she shows signs of moulting.

Selecting the Breeding-hens.

The culls having been removed from the flock, the next important step is to choose the prospective breeding specimens. In this connection it is not to be inferred that all late moulters which give indications of being heavy layers are desirable breeding specimens, for the best layer is not necessarily the best breeding-bird. Breed and laying type, the desired size, together with points indicating constitutional vigour, must be combined if desirable progeny is to be produced. For example, a freak type of bird may prove to be a heavy layer, but, if bred from, its progeny in all probability would prove disappointing. To maintain a flock of heavy producers, the breeder must have an ideal type pictured in his mind's eye, and choose birds as near to this as it is possible to do. Breeding from hens of various types and sizes merely because they have good egg-laying performances behind them is no doubt responsible, to a considerable extent, for much of the weak stock being bred at the present time. The danger of improving one characteristic by weakening another should always be kept in mind. In addition to possessing maximum laying points, the ideal breeding-bird should be at least a fair specimen of the breed it represents. In other words, it should conform to breed type, and have good bodily development. Not only should the back be broad, but there should be a good depth of body, well developed in front, and in the abdominal region. In selecting breeding specimens whether males or females, the first essentials to look for are points indicating strong constitutional vigour. However well a fowl may lay, if she does not possess the desired constitutional points she should not be bred from. The breeding specimen should always be an active bird and never of a sluggish temperament.

It seems well again to emphasize the importance of weeding out all inferior stock, and also of selecting the breeding-stock at the earliest possible moment, for the reason that it is impossible to efficiently carry out this work after the moult has set in.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

Final Extracting for Main Honey-flow.

FEBRUARY will probably see the end of the main honey-flow in most districts, and beekeepers will be wise to remove the last of the honey before the colder nights arrive. Once the honey in the hives has been allowed to become thoroughly chilled there is little prospect of its becoming warmed again when uncertain weather sets in. Wherever it is inclined to be thick the honey will be found exceedingly difficult to extract unless it is warm, and the beekeeper who delays too long will find that he will have to return to the hives combs almost as heavy as when they were removed. Thin honey extracts best when it is warm, but it is imperative that thick honey be not allowed to cool before extracting.

Condition of the Brood-chamber.

One of the principal matters to be attended to when the last of the honey is being removed is the condition of the brood-chamber. Many prolific queens keep the brood-chamber so full of brood throughout the season that the bees have very little room to store honey in it. Consequently, if all the honey in the supers is removed such colonies stand a chance of being starved out before the end of the winter. These colonies should not be reduced to less than two stories, and on no account should their stores be less than 30 lb. to 40 lb. It must be borne in mind that all the brood in the hive will hatch and must be fed, and that in addition the queen will continue laying for some months to come, while in some districts breeding may continue throughout the winter. To ensure the colony coming out strong in the spring it must be left with ample stores to carry it through the months of dearth. Unless there is ample evidence of an abundant autumn flow, the beekeeper would be wise to leave his hives oversupplied rather than undersupplied.

Use of Bee-escapes.

For the comb-honey producer the Porter bee-escape is an invaluable aid in the removal of his crop. Removal of comb-honey by the ordinary method of brushing, &c., is apt to result in the piercing of many cell-cappings, with constant leakage; but by the use of this simple little appliance, fitted in a board the size of a super, comb-honey can be removed without any disturbance of the colony. The super or supers should be prized up from the brood-chamber, two or three puffs of smoke driven into the hive, and the board gently slipped into place with the round hole of the escape uppermost. If this is done in the afternoon, by morning the super will be empty of bees.

Prevention of Robbing.

The taking of the last of the honey is the time when the beekeeper must display endless caution to prevent robbing. A bad attack of autumn robbing is—next to disease—about the worst thing a beekeeper can experience. Before starting the day's work he should have all appliances handy, have formed a plan of how the work is to be carried out, and should, if it is satisfactory, adhere to that plan throughout the day. A light barrow fitted with a tray to catch honey-drips, and two or three cloths of a size to cover the whole of a super are some of the things which will obviate much trouble. As the combs are removed from the supers they should be brushed and shaken as free of bees as possible, placed in an empty super on the barrow, and covered with a damp cloth. Every hive should be closed as soon as it is finished with, and the combs removed to the honey-house, which should be bee-proof. At the close of the day the wet combs should be returned to the hives as expeditiously as possible, and by morning the apiary will be found to be in its normal condition. No pieces of wax, spilt honey, or anything likely to attract the attention of the bees should be left uncovered.

If the bees show a tendency to pounce on any particular hive the entrance should be contracted considerably and wet grass piled in front of the hive. If working in one portion of the apiary should cause robber bees to become too attentive it is advisable to shift the scene of operations to another part. It must be borne in mind that autumn robbing once commenced is hard to check and also that it is usually brought about by careless manipulation of the hives.

Weak Colonies.

As far as possible, weak hives should not be tolerated during the winter months. During the warm days these stocks rarely escape the attention of robber bees, and are easily molested. Once they are attacked

it is exceedingly hard to save them, and despite the efforts of the beekeeper they eventually get robbed out. It is usually the presence of weak hives in the apiary that starts autumn and winter robbing, and it is by far the best plan to unite them with stronger colonies in the apiary and avoid the risk of creating a disturbance among the bees when normal winter conditions should prevail. If weak colonies are not detected until late in the season a good plan to follow when uniting them is to put the weak hive on top of a strong one, placing a piece of newspaper between the two hive-bodies. In the course of a few days the bees in the weaker hive will eat their way through the paper and unite peaceably with the bees in the stronger hive. The surplus combs may subsequently be removed, and the hive made snug for wintering. If weather conditions permit, it is advantageous to destroy the queen in the weaker hive prior to uniting.

Preparations for Winter.

As soon as the last of the honey is removed the beekeeper should see that the colonies are in good order for wintering. The first matter for attention is that of stores, which, as already indicated, should be abundant; the second that of the queen's condition. After these two important matters are settled the beekeeper should satisfy himself that his hives are watertight and draught-proof, also that his apiary is well provided with shelter in the form of good hedges or other wind-breaks.

With regard to the queen, autumn is the time when strict attention should be paid to weak and failing queens. None but the best queens should be allowed to go into winter quarters. Poor queens should be destroyed, and either superseded by young and vigorous ones or their colonies united with those of the better queens before the winter sets in. No queen should be tolerated which cannot provide the colony with an abundant supply of young workers before the cold weather arrives. It is quite certain that the queen which goes back in the autumn will be in worse condition after the winter, and will not produce enough workers to provide a surplus in the following season, even if she does not fail entirely before the spring or develop into a drone-layer as soon as brood-rearing commences.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Vegetable Crops.

THE keeping quality of the onion crop in ordinary storage depends very largely on the methods of harvesting and on the conditions in the store. Bulbs with thick necks and deformed ones are unsuitable for long storage, and should be used up at once; but sound bulbs carefully handled to avoid bruising, and with roots and tops thoroughly dried off, have quite good keeping qualities if the conditions in storage are dry, cool, and airy. The conditions just named are indispensable: humidity, occasional high temperatures, and a stagnant atmosphere will quickly depreciate the crop and shorten life. High temperatures are sometimes locally induced by close stacking of considerable quantities, which must be avoided. Moderate quantities may be strung, in the old-fashioned way, and hung up; but in any case ample provision should be made for the cool, dry air to circulate freely through the stored bulbs.

To provide young "spring onions" at that season when salads are so much in demand, a sowing should be made now. For this purpose the Rocca or Tripoli types are most suitable, owing to their mild flavour and tender flesh. In the warmer districts, especially, this crop grows well with little

trouble, and it is generally advisable to make a generous sowing for the purpose above mentioned, and also for planting out the main crop during the month of July instead of making a spring sowing. This method provides an all-the-year-round supply in localities where spring-sown crops are difficult to ripen satisfactorily. The land selected for sowing now should be well drained and thoroughly cleaned of weeds by fallowing and shallow cultivation for some time before sowing.

Pumpkins and squashes are useful for winter supplies in the kitchen. If they are ripe, properly harvested, and stored, they have excellent keeping qualities. It is important that they be well-matured, and cut with a stem attached to the fruit. They should then be allowed to remain where grown for a while to ripen. Subsequently they must be handled and carted with care, as they are easily injured seriously at this stage. When they are stored in a warm airy place for a few weeks their shells harden, and they will then stand somewhat lower temperatures and rougher handling if that is necessary.

On light land and in dry localities where the celery crop is grown in trenches preparation should be made for blanching the plants as required. Suckers and dead leaves about the base of the plants should be removed and such water and liquid manure as may be required should be supplied. In fine weather when the soil is in friable condition it is advisable to gather the leaves of each plant together, and to hold them in position by means of a line with which a turn is taken about each plant, the ends of the line being fastened to pegs in the ground. The soil for filling should be broken fine and filled to a depth of about 4 in. about each plant, and the line then removed. By repeating the operation twice at intervals of about a fortnight the process is completed, and about four to six weeks later the crop will be ready for lifting as required. The plants should be nearly full grown before this operation is commenced. For early crops of the self-blanching varieties, grown without trenches, boards 10 in. to 12 in. wide or stout building paper of that width are laid along the rows. Late varieties grown in the same way are best banked with a mould plough, working the soil up to the plants gradually at intervals.

Sowing of lettuce for winter use and of spinach for spring cutting is seasonable.

Light cultivation to keep down weeds should be given in fine weather to crops sown or planted early in the new year.

Vitamins and Vegetables.

The importance of a good supply of fresh vegetables and fruit in the daily diet has been advocated generally for some time. Such distressing troubles as scurvy, beri-beri, rickets, pellagra, &c., it is well known, may be avoided or cured by the inclusion of such foods in the diet. Acute attacks of such deficiency diseases are usually confined to those engaged in heavy manual labour, but "it is now becoming generally recognized that much subnormal health and development, and even incidence of disease, are associated with a partial deficiency of one or more of these accessory substances (vitamins). The influence of such partial deficiencies, even when relatively slight, may be extremely serious." The quotation is from "A Survey of Present Knowledge of Vitamins," by the Medical Research Council, and published by H.M. Stationery Office, London; 6s. 6d. net. The volume contains important information of general interest, especially to those engaged in the production of primary edible products, and particularly vegetables and fruit.

The first clear evidence of the existence of dietary factors of the nature of vitamins was produced by a physiologist, Lunin, at Basel in Switzerland in 1881. Since then the matter has been the object of research in many

countries, but it was Casimir Funk of the Lister Institute who, in 1907–10, did a great deal of work in the endeavour to actually isolate the active substance to which he give the name of vitamin.

As these accessory food factors called vitamins are sensitive to high temperatures, the value of fresh vegetables and fruit may be greatly impaired by cooking. It appears that the vitamins are best preserved generally by cooking the fruit or vegetables in a small quantity of water for the shortest period of time required to get them tender.

Small-fruit Crops.

Where it is purposed to plant any of these crops, and the necessary shelter-belts, during the month of May, the preparation of the land should now be given every attention, as it is important that the land be thoroughly clean, rich, and deeply cultivated before the plants are set out. Any drainage necessary should also be attended to. The commonest cause of failure is hurried and incomplete preparation at the last moment. Planting permanent crops of this kind should never be done until all twitch and other bad weeds are completely eradicated.

The Homestead Garden.

The present time is most suitable for sowing down new lawns or repairing old ones so long as they can be given a rest from hard wear. The good appearance of a lawn depends on its height and an even well-graded surface; its extent in proportion to the vertical masses about it; and an outline that is straight or in bold curves that give it interest. As the lawn is a feature that is usually of first importance in the garden, these points should be carefully considered. A lawn that has its surface pitched too high and a 6 in. or 10 in. verge beside the drive or walks has its appearance heavily discounted, as also is that of a lawn which sags away from the walks on a lower level: an inch or two above the water-table of the drive or walks is usually a suitable height.

An easy natural slope from the dwelling is usually the best grade for the surface. A surface that is approximately level does not look so well, and should only be made for the purpose of games that require it; but in either case it is important that the surface should be smooth, and it is this that takes time, patience, and labour to secure. A smooth surface is best obtained by cultivating the ground to an even depth, breaking it up fine, and giving it time to settle thoroughly. Then by raking it out smooth, rolling it well, and then raking it well again a satisfactory surface may be obtained, or the treatment may have to be repeated to get the desired result. It is important to see that there is at least 6 in. or 8 in. of good soil on the surface: better still is it to have the black soil of equal depth over the whole area. Uneven growth of grass in a lawn is often due to the land being levelled without any regard to the depth of black soil, and, as a consequence, considerable areas of turf have sometimes little more than clay beneath.

The experiments now being carried out in green-keeping by the Plant Research Station at Palmerston North indicate that it is generally advisable to apply a dressing of fertilizers before sowing down a lawn. On the heavy river silt on which the experiments are being carried out the following mixture is being used: 6 parts of superphosphate, 3 parts sulphate of ammonia, 4 parts nitrate of soda, and 2 parts of sulphate of iron applied at the rate of 1 oz. of the mixture per square yard every three months. This should be raked in after levelling and followed by the seed, sown evenly, at the rate of 1 oz. to 1 or 2 square yards. Calm weather is necessary for this operation. The seed should be raked in smoothly and then no more attention is necessary until the grass is sufficiently high for cutting. The fertilizers should be mixed immediately before sowing, and finely ground sulphate of iron should be used.

Patches in an established lawn that are worn bare may be seeded down now, but generally it is best to returf them neatly with good turf composed of fine grasses similar to the remainder of the lawn.

The shrubbery and herbaceous borders in a new garden should be deeply cultivated—trenched for preference—thoroughly cleaned of all bad weeds, and the herbaceous border especially should be generously treated with a dressing of decayed farm manure worked in chiefly in the bottom of the trench. This work should be done now so that the land can settle down and be ready for planting about the month of May, which is the commencement of what is known as the planting season. During the interval before planting occasional light hoeing should be done in fine weather to destroy seedling weeds; the land will then be sweet and clean when planting-time arrives. Further, meanwhile the selection of the plants and their arrangement should be given a great deal of consideration, as the use of plants suitable to the locality and tastefully arranged is naturally a matter of first importance.

Old shrubbery borders that lack interest may often be greatly improved by some replacements or additions. Tree ferns and palms may be added to afford variety, and flowering shrubs to provide colour at any season that may be desired. Careful study of local gardens and a visit to the nursery will suggest subjects suitable for either purpose.

—W. C. Hyde, Horticulturist, Wellington.

On page 300 of the November, 1933, issue of the *Journal* a statement relative to Webb's Masterpiece occurs. In this instance the swede used was not Webb's Masterpiece.

In a progress report on investigations at the Plant Research Station, Palmerston North, relative to the production of ten varieties of lucerne, nine of which were of overseas origin, it is indicated that Marlborough (New Zealand) type excelled all the others.

A large amount of experimental work has been carried out in recent years, and the result is to show conclusively that the objections to the use of the so-called physiologically acid manures have been the result of misconceptions or possibly even misrepresentations. The use of superphosphate does not generally increase the acidity of the soil.—*Extract from Presidential Address, Agric. Section Brit. Assocn., 1933.*

Sowing down Golf-greens.—In its report on Green-keeping Research the Agrostology Section Plant Research Station says: "A mixture of brown-top and Chewings fescue (one part brown-top to two parts Chewings fescue, at the rate of 1 oz. of the mixture to the square yard) has definitely given the best results to date, and the inclusion of other species in the mixture at present does not seem to be warranted under the conditions of our trials at least. As far as rapid and strong early competitors in the mixture, such as rye-grass and crested dogstail, are concerned, these have definitely shown to be inimical to the establishment and well-being of the finer-leaved grasses. As far as the slower-establishing species in the mixtures are concerned, it is yet too early to give any information regarding these. There is now at the end of twelve months practically no difference between the heavy seeding and the light. It must, however, be borne in mind that the light seeding here is still fairly heavy. From the general swards sown out with 1 oz. of mixture to the square yard, it would appear we can depart very little from this as a standard recommendation. Soil fertility, condition of the seed-bed, weather conditions, even spreading of seed, depredations of birds, &c., all must be taken into account when recommending quantities to sow and heavy applications rather than light should be the rule. The correct fertility standard to set in order to maintain a nice blending of brown-top and Chewings fescue is important. The general thesis at present is that too high manuring plus watering will favour brown-top at the expense of the Chewings and low manuring plus dry conditions will favour Chewings fescue at the expense of the brown-top."

WEATHER RECORDS: JANUARY, 1934.

Dominion Meteorological Office.

NOTES FOR DECEMBER.

PEOPLE generally regarded January as a changeable and unpleasant month. It was cold and windy for midsummer. To the meteorologist, also, the weather was rather abnormal. This was due principally to the unusually pronounced development of the summer monsoon in Australia. In the middle of the month a severe heat spell was experienced there. Air was being poured out from the Continent in a westerly direction and had a pronounced influence on conditions in New Zealand.

Rainfall.—In the North Island the heavy rains of the 28th and 29th brought the total month's fall above the average in coastal areas from Kawhia to the South Taranaki Bight, and in parts of the Hawke's Bay and Wairarapa districts. In the west some of the excesses were large. The remainder of the North Island had less rain than average, very dry conditions being experienced in most of the Auckland Province.

In the South Island there were very heavy rains along the east coast and extending over most of the interior of Canterbury and southern Nelson and Marlborough. Double the average fall was recorded in places. In northern Nelson and the interior of Marlborough, South Canterbury, Otago, and Southland, the situation was reversed, the totals being much below normal.

Temperatures.—The month was abnormally cool. In practically all parts the mean temperature was much below the January average. Particularly was this the case in the Waikato, Taranaki, and Manawatu districts. On the morning of the 23rd there was a rather widespread frost which, though only light, was sufficient at this time of year to do considerable damage to tender crops.

Sunshine was much below normal in the eastern portions of South Canterbury and Otago. Elsewhere there was little departure from the average, but generally it was slightly below.

Pressure Systems.—The first stormy period began on the 2nd, and conditions remained unsettled in the South Island until the 7th. Rain was fairly general in the latter area and there were some very heavy falls in Canterbury. On the 5th they were accompanied by thunderstorms and heavy hail, which did much damage to wheat crops.

The next disturbed period was from the 11th to the 14th, and was caused by a somewhat similar depression to that responsible for the first. Again there were heavy rains with some hail and thunder in parts of Canterbury.

A series of westerly depressions between the 18th and 22nd, though at most places they did not produce much rain, were responsible for some rather unusual and unpleasant phenomena. The depressions were followed by a sharp fall of temperature and on the 23rd, as has already been mentioned, a frost occurred.

The weather again became unsettled after the 23rd. At first, westerly depressions crossing the South Island caused heavy rain in the high levels, especially on the 25th, when there were thunderstorms on the west coast. Elsewhere there was comparatively little rain. At this stage a zone of low pressure lay across the central part of the Dominion, and in the following days it moved very slowly northwards. Though it was not very marked, it was responsible for widespread rains on the 28th and 29th. The disturbance was of a very unusual kind and due to the outpouring in the upper levels of warm air from Australia.

Rainfalls for January, 1934, at Representative Stations.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average January Rainfall.	Total for Year to Date.	Average for Year to Date.
	North Island.					
	Inches.		Inches.	Inches.	Inches.	Inches.
Kaitaia	0·21	5	0·11	3·94	0·21	3·94
Russell	1·62	5	0·65	3·25	1·62	3·25
Whangarei	3·41	8	1·95	3·93	3·41	3·93
Auckland	1·57	10	0·59	2·72	1·57	2·72
Hamilton	2·99	9	0·93	3·57	2·99	3·57
Rotorua	2·97	8	0·91	4·26	2·97	4·26
Kawhia	5·45	14	1·78	3·55	5·45	3·55
New Plymouth ..	6·14	18	3·80	4·19	6·14	4·19
Riversdale, Inglewood ..	5·61	19	2·82	7·51	5·61	7·51
Whangamomona ..	2·98	6	1·16	5·58	2·98	5·58
Hawera	3·76	14	1·48	3·51	3·76	3·51
Tairua	0·87	7	0·38	3·66	0·87	3·66
Tauranga	2·08	6	0·61	4·08	2·08	4·08
Maraehako Station, Opotiki	1·40	5	1·06	3·59	1·40	3·59
Gisborne	2·28	8	1·47	2·72	2·28	2·72
Taupo	2·02	7	0·93	3·37	2·02	3·37
Napier	2·93	10	1·10	2·93	2·92	2·93
Hastings	1·99	9	0·84	1·93	1·99	1·93
Whakarara Station ..	..	..	..	..	..	..
Taihape	2·40	13	0·55	3·20	2·40	3·20
Masterton	2·57	8	1·01	2·60	2·57	2·60
Patea	5·30	13	2·28	3·59	5·30	3·59
Wanganui	4·58	11	0·86	2·83	4·58	2·83
Foxton	2·17	7	1·00	2·14	2·17	2·14
Wellington	2·03	13	0·53	2·81	2·03	2·81
	South Island.					
Westport	10·30	17	2·28	8·20	10·30	8·20
Greymouth	8·73	16	1·69	9·17	8·73	9·17
Hokitika	8·20	16	1·53	10·07	8·20	10·07
Ross	12·15	13	3·53	12·40	12·15	12·40
Arthur's Pass ..	14·97	12	5·30	14·12	14·97	14·12
Okuru, South Westland	..	..	..	12·59	..	12·59
Collingwood	3·20	14	0·83	6·71	3·20	6·71
Nelson	0·74	9	0·22	2·81	0·74	2·81
Spring Creek, Blenheim	0·80	5	0·25	2·22	0·80	2·22
Hanmer Springs ..	7·42	10	2·49	3·90	7·42	3·90
Highfield, Waiau ..	5·35	7	3·06	2·98	5·35	2·98
Gore Bay	4·83	10	2·12	2·46	4·83	2·46
Christchurch	3·44	15	0·93	2·18	3·44	2·18
Timaru	7·22	16	1·80	2·27	7·22	2·27
Lambrook Station, Fairlie	4·59	10	1·82	2·43	4·59	2·43
Benmore Station, Clearburn	1·51	12	0·76	2·77	1·51	2·77
Oamaru	3·69	16	0·97	2·04	3·69	2·04
Queenstown	1·17	9	0·37	2·92	1·17	2·92
Clyde	1·68	7	0·59	1·85	1·68	1·85
Dunedin	5·08	13	1·90	3·43	5·08	3·43
Wendon	2·17	9	0·80	3·20	2·17	3·20
Gore	..	..	..	3·08	..	3·08
Invercargill	3·68	17	0·68	4·01	3·68	4·01
Puysegur Point ..	6·50	21	2·44	7·62	6·50	7·62
Half-moon Bay ..	5·03	24	0·54	4·82	5·03	4·82